

**ADVANCED SUBSIDIARY GCE  
 BIOLOGY**

**2801**

Biology Foundation

**TUESDAY 16 JANUARY 2007**

Afternoon

Time: 1 hour

Additional materials:  
 Electronic calculator  
 Ruler (cm/mm)



Candidate  
 Name

--

Centre  
 Number

--	--	--	--	--

Candidate  
 Number

--	--	--	--

**INSTRUCTIONS TO CANDIDATES**

- Write your name, Centre Number and Candidate Number in the boxes above.
- Answer **all** the questions.
- Use blue or black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure you know what you have to do before starting your answer.
- Do **not** write in the bar code.
- Do **not** write outside the box bordering each page.
- WRITE YOUR ANSWER TO EACH QUESTION IN THE SPACE PROVIDED. ANSWERS WRITTEN ELSEWHERE WILL NOT BE MARKED.

**INFORMATION FOR CANDIDATES**

- The number of marks for each question is given in brackets [ ] at the end of each question or part question.
- You will be awarded marks for the quality of written communication where this is indicated in the question.
- You may use an electronic calculator.
- You are advised to show all the steps in any calculations.

FOR EXAMINER'S USE		
Qu.	Max.	Mark
1	11	
2	15	
3	12	
4	14	
5	8	
<b>TOTAL</b>	<b>60</b>	

**PLEASE DO NOT WRITE ON THIS PAGE**

Answer **all** the questions.

- 1 (a) Complete the following passage by inserting the most suitable terms in the blank spaces.

Living organisms are interacting constantly with each other and with the environment. Each individual organism is a member of a group, the ..... , which consists of all the individuals of a species in an area. This area is known as the ..... . All the organisms of the different species in an area form a group called the ..... . All the species and the non-living components interacting within an environment are collectively known as the .....

Photosynthetic organisms such as green plants form the first feeding or ..... level in the food chain and are known as ..... because they can manufacture their own food. Animals are dependent upon the photosynthetic organisms to obtain energy and are known as ..... [7]

- (b) In coastal regions, unusually high tides can cause flooding of land that is not normally covered by sea water.

Explain how plants living in these regions would be affected by the change in water potential ( $\Psi$ ) of the soil caused by such flooding.

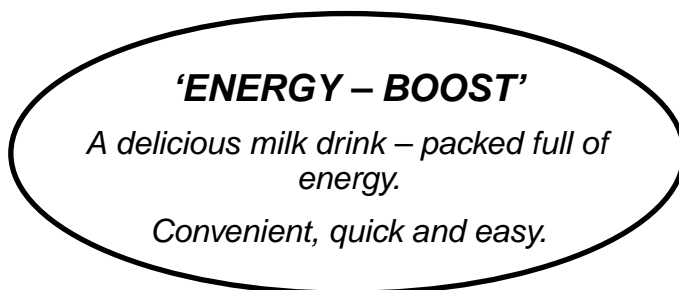
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
..... [4]





- 3 'Health – Milk' and 'Energy – Boost' are flavoured milk drinks.

The manufacturers make the following claims:



The two different flavoured milk drinks and a sample of fresh milk were all tested for the presence of some biological molecules.

The methods used and the results obtained are shown in Table 3.1.

**Table 3.1**

method used	colour change observed for		
	fresh milk	'Health – Milk'	'Energy – Boost'
a few drops of iodine solution added	remains yellow	remains yellow	remains yellow
5 cm <sup>3</sup> biuret solution added	blue to lilac	blue to lilac	blue to lilac
5 cm <sup>3</sup> Benedict's reagent added and solution boiled	blue to green	blue to green to yellow	blue to green to yellow to orange
<ul style="list-style-type: none"> <li>• sample that has been tested with Benedict's reagent is filtered</li> <li>• the filtrate (solution) is boiled with 5 cm<sup>3</sup> dilute acid, cooled and neutralised</li> <li>• then 5 cm<sup>3</sup> Benedict's reagent is added and the</li> </ul>	remains blue	blue to green to yellow to orange	blue to green to yellow to orange to red

(a) Using **only** the information in Table 3.1, state the biological molecules present in

(i) fresh milk;

.....  
..... [2]

(ii) 'Health – Milk'.

.....  
..... [3]

(b) What **differences** between 'Health – Milk' and 'Energy – Boost' are identified by the information in Table 3.1?

.....  
.....  
.....  
..... [2]

(c) Explain why the claims made by the manufacturer for 'Health – Milk' could be misleading.

.....  
.....  
.....  
.....  
.....  
..... [3]

(d) Suggest why it would **not** be appropriate to test milk for lipids using the emulsion test.

.....  
..... [1]

(e) Milk is a good source of calcium in the human diet.

State **one** use of calcium in the body.

..... [1]







- 5
- DNA is found in the nucleus of a cell.
  - During interphase DNA replicates.
  - DNA is involved in the transcription stage of protein synthesis.

The following statements, **A** to **H**, refer to events that may take place during:

- ◆ DNA replication **only**
- ◆ transcription **only**
- ◆ **both** DNA replication **and** transcription
- ◆ **neither** DNA replication **nor** transcription.

Complete the table by marking the appropriate boxes with a tick (✓) if the event takes place or a cross (X) if it does not take place.

		DNA replication	transcription
<b>A</b>	Nucleotides line up along an exposed DNA strand.		
<b>B</b>	The whole of the double helix 'unzips'.		
<b>C</b>	Uracil pairs with adenine.		
<b>D</b>	A tRNA triplet pairs with an exposed codon.		
<b>E</b>	Both DNA polynucleotide chains act as templates.		
<b>F</b>	Adjacent nucleotides bond, forming a sugar-phosphate backbone.		
<b>G</b>	The original DNA molecule is unchanged after the process.		
<b>H</b>	Adenine pairs with thymine.		

[8]

[Total: 8]

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Fig. 4.1 Dr D J Taylor

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**Biology**

Advanced GCE **A2 7881**

Advanced Subsidiary GCE **AS 3881**

**Mark Schemes for the Units**

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**January 2007**

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**Mark Scheme 2801  
January 2007**

Question	Expected Answers	Marks
1 (a)	<p>population;            habitat;            community;            ecosystem;</p> <p>(first) trophic; <b>R</b> <i>tropic</i>            producers/(photo) autotrophs/autotrophic;            (primary) consumers/heterotrophs/heterotrophic/herbivore;  <b>R</b> <i>carnivore/other qualified consumer</i></p>	7
(b)	<p>1 (water moves) by osmosis;            2 down water potential gradient/from high <math>\Psi</math> to low <math>\Psi</math>;                (less negative to more negative)            3 sea water has low water potential/(soil) water potential decreased;                (more negative)            4 <math>\Psi</math> , gradient reduced/lower than inside , root/cells/plant;            5 plant , loses/can't absorb (as much) , water;            6 cells , flaccid/lose turgor;            7 plasmolysis/described;            8 wilting/poor growth; in correct context</p> <p><i>Credit suitable equivalent marking points if they state that internal and external <math>\psi</math> are equal</i></p>	4 max
<b>[Total: 11]</b>		



Question	Expected Answers	Marks
3 (a) (i)	<p>Mark the first 2 types of biological molecule stated. Absence = neutral protein; <b>A</b> casein/polypeptide <b>R</b> amino acid reducing sugar(s); <b>A</b> correctly named reducing sugar(s) [but only lactose/galactose/glucose]</p>	2
(ii)	<p>Mark the first 3 types of biological molecule stated. Absence = neutral protein; <b>A</b> casein/polypeptide <b>R</b> amino acid reducing sugar(s); <b>A</b> correctly named reducing sugar(s) [but only lactose/galactose/glucose/fructose] non-reducing sugar; <b>A</b> sucrose</p>	3
(b)	<p>Assume 'it' = 'Health-Milk'</p> <p>'Health – Milk' has less reducing sugar(s); <b>A</b> correctly named reducing sugar(s) [but only lactose/galactose/glucose/fructose] less non-reducing sugar; <b>A</b> sucrose</p> <p>"less sugar" = 1 credit converse statements relating to 'Energy - Boost'.</p>	2
(c)	<p>states 'no added sugar'/implies low sugar; contains more sugar than (fresh) milk/high in sugar; more reducing sugar (than milk); <b>R</b> 'none in fresh milk' has non-reducing sugar (compared to none in milk); fruit (extract) must contain (hidden) sugar;</p>	3 max
(d)	<p>milk/drinks , already , milky/cloudy/white/opaque/'not see through'/emulsion; <b>A</b> 'positive result would not show up' <b>R</b> precipitate</p>	1
(e)	<p>question states '<u>use of</u>' so <b>R</b> 'found in...'</p> <p>formation/strengthen , bones/teeth; nerve impulses/transmission across synapses/between neurones; muscle contraction; spindle formation; blood clotting; enzyme cofactor;</p>	1 max

[Total: 12]

Question	Expected Answers	Marks
4 (a) (i)	<p>R statements linked to amylose/starch  max 3 if stated that glycogen <u>is</u> amylopectin</p> <p>polymer/polysaccharide/described;  (made of) <math>\alpha</math>-glucose;  joined by 1,4 links;  glycosidic;  (chain is) branched;  1,6 links where branches attach;  AVP; e.g. compact  detail of glycosidic bond</p>	4 max
(ii)	condensation; A polymerisation	1
(b) (i)	37 °C; A any figure in the range 35 - 40	1
(ii)	<p>(enzyme) increases in kinetic energy; A 'too much kinetic energy'  enzyme vibrates too much;  breaks bonds;  named eg;  changes , tertiary/3-D , structure/shape , of enzyme;  active site changes , shape/AW;  substrate will not fit/no enzyme-substrate complex formed;  enzyme denatured;  will , decrease rate/stop reaction;</p>	4 max
(c) (i)	mitochondrion; A mitochondria	1
(ii)	<p>(liver requires) a lot of , energy/ATP;  R statements including 'produce/create/make , energy'</p>	1
(d) (i)	46/23 pairs;	1
(ii)	mitosis; R any possible confusion with meiosis	1

[Total: 14]

Question	Expected Answers	Marks
5	1 mark per correct row	
	<i>Look for both ticks and crosses.</i>	
	<i>If a table consists of ticks ONLY or crosses ONLY, then assume that the blank spaces are the other symbol.</i>	
	<i>If a table consists of ticks, crosses and blanks then the blanks represent no attempt at the answer.</i>	
	Nucleotides line up along an exposed DNA strand.	✓ ✓;
	The whole of the double helix 'unzips'.	✓ ✗;
	Uracil pairs with adenine.	✗ ✓;
	A tRNA triplet pairs with an exposed codon.	✗ ✗;
	Both DNA polynucleotide chains act as templates.	✓ ✓;
	Adjacent nucleotides bond, forming a sugar-phosphate backbone.	✓ ✓;
	The original DNA molecule is unchanged after the process.	✗ ✓;
	Adenine pairs with thymine.	✓ ✓;
		8
		<b>[Total: 8]</b>

**Mark Scheme 2802**  
**January 2007**

Question	Expected Answers	Marks
1 (a)	(clinically) obese/obesity; <b>R</b> <i>morbidly obese</i>	1
(b)	<i>Diet B</i> essential fatty acids/linoleic acid/linolenic acid/fat soluble vitamins/A/D /E/K;  <i>Diet C</i> sugars/named sugar/starch; <b>A</b> <i>vitamin C</i>	2
(c) (i)	B; energy intake (of B) is lower ORA;	2
(ii)	energy intake is less than energy used ORA;	1
(d)	(no fruit may mean) scurvy/described; <b>R</b> <i>vitamin C deficiency unless qualified</i>  raised, cholesterol/LDL, levels in blood; <b>R</b> <i>intake</i> fatty substances deposited <u>in</u> artery walls/atherosclerosis; <u>coronary</u> arteries; narrows lumen; reduces, blood/oxygen, delivered to <u>heart muscle</u> ; CHD/heart attack/angina; thrombosis/clot; raised blood pressure/hypertension; stroke;  stress on liver; stress on kidney; due to excess protein/amino acids/urea;  AVP; AVP; e.g.      deposition of subcutaneous fat/AW obesity stress on joints anorexia/bulimia/obsession on diet constipation bowel cancer hypoglycaemia giddiness lethargy/fatigue/tiredness [ <i>but R 'lack of energy'</i> ]	3 max

[Total: 9]



Question	Expected Answers	Marks
2	physical; disease/illness/sickness; carbohydrates; animal/saturated; 20; <b>A</b> <i>from 20 to 60</i> 70;	6
		<b>[Total: 6]</b>



Question	Expected Answers	Marks
4 (a)	<p>different methods of recording statistics;  inaccurate recording of, cause of death/incidence of coronary events;  poor diagnosis/ORAs;  coronary event may not be CHD;  not all (coronary) events cause, mortality/death;  higher standard of health care (can prevent deaths)/AW/ORAs;  smoking increases chance of death due to a coronary event (cf. Russia and Finland);</p> <p>AVP; e.g.      availability of, equipment/trained staff/drugs  speed of medical response  different levels of exercise/active lifestyle  different levels of obesity  different diet  different genetic (predisposition)  qualified ref to air pollution</p>	<b>3 max</b>
(b)	<p>no relationship between prevalence of smoking and incidence of coronary events; <b>A statement that country X (Russia) has high prevalence smoking and high incidence of coronary events while country Y (Scotland or Finland) has low prevalence and high incidence</b></p> <p>use of figures to compare;  e.g.: compare China <b>and</b> Russia (both about 68% prevalence of smoking but China has 90 (85-95) per 100 000 coronary events, while Russia has 480 (470-490) per 100 000 coronary events)</p> <p>no relationship between prevalence of smoking and mortality from CHD;  <b>A statement that country X (Russia) has high prevalence smoking and high incidence of mortality while country Y (Germany) has high prevalence and low incidence</b></p> <p>use of figures to compare;  e.g.: compare China <b>and</b> Russia (both 68% prevalence but China has 110 (105-115) per 100 000 deaths while Russia has 710 (705-715) per 100 000 deaths)</p>	<b>2 max</b>

- (c) *mark comments on government strategy only, reject references to personal steps*

*qualified reference to*

education/advice;

improve diet of population; e.g. food labeling/'five a day'

screening of population;

reducing levels of obesity in population;

increasing level of exercise in population;

*provision of:*

specialist paramedics;

more/better equipped, ambulances;

more resuscitation equipment; **A** *ref to funding for equipment*

specialist cardiac care in hospitals/AW; **A** *ref to funding for cardiac care*

improved training of medical personnel;

AVP; e.g. provide money for, equipment/training of first aiders, in workplace

provide drugs/beta blockers/statins

anti-smoking adverts

tax on tobacco/cigarettes

anti smoking legislation [*eg ban smoking in public places*]

increase funding for research into reducing mortality

legislate to improve quality of food

**3 max**

**[Total: 8]**

Question	Expected Answers	Marks
5 (a) (i)	<i>Vibrio cholerae/Vibrio</i> ;	1
(ii)	in faeces/faecal contamination; <b>A</b> in sewage in water/food;	2
(b)	<p>1 drinking water not treated/sewage not treated; <b>R</b> ref to cleaning water</p> <p>2 water not piped to houses;</p> <p>3 sewage contaminates drinking water;</p> <p>4 untreated/raw, human sewage used to fertilise crops;</p> <p>5 people not washing their hands after using bathroom;</p> <p>6 ref. to non hygienic preparation of food;</p> <p>7 shellfish feed on untreated sewage;</p> <p>8 easily, spread/transmitted;</p> <p>9 symptomless carriers;</p> <p>10 overcrowding in LEDCs;</p> <p>11 poor, housing standard/sanitation;</p> <p>12 (outbreaks/epidemics), often occur after, (natural) disasters/war;</p> <p>13 (due to) transport problems/difficult to get help;</p> <p>14 refugees/migration;</p> <p>15 vaccine not effective;</p> <p>16 provides only short-term immunity;</p> <p>17 new/many, strains of bacteria; <b>R</b> strands</p> <p>18 arise due to mutation;</p> <p>19 which are, antibiotic/drug-resistant;</p> <p>20 pathogen/bacteria, lives in gut;</p> <p>21 immune system not effective;</p> <p>22 qualified ref. to lack of education;</p> <p>23 poor primary health care;</p> <p>24 isolated villages so can't reach medical help;</p> <p>25 qualified ref to, economic/political, argument;</p> <p>26 AVP; e.g. reference to oral vaccine needed, extra detail of antigenic drift, ref. to why oral antibiotics may not be effective (peristaltic rush)</p>	7 max 1
	<b>QWC – clear well organised using specialist terms;</b>	

[Total: 11]

Question	Expected Answers	Marks
6 (a)	plasma/effector; <b>A B, lymphocyte/cell</b>	1
(b) (i)	bind/attach to <u>antigen</u> ;  hold, shape/tertiary structure, of molecule; hold (polypeptide) chains together/maintain quaternary structure; <i>max 1</i>  attach/bind to, phagocyte;  allow molecule to, bend/flex/bind with more than one pathogen/AW; <b>R allow molecule to move</b>	4
(ii)	(different antibodies) have different amino acid sequence; (different antibodies) have different shape; (different antibodies) fit different antigens; ref. to specificity/complementary; <b>A lock and key</b>	2 max
(c) (i)	<i>time taken for</i> antigen presentation/AW; clonal selection/AW; clonal expansion/AW; differentiation (of B cell into plasma cell); production of antibodies; there are no memory cells; AVP; e.g. more detail of one of the above	2 max
(ii)	rise starts between day 31 and 35; rise is steeper and rises higher (50au) than first response; concentration declines, more slowly/with less steep gradient;	2 max
(d) (i)	mutation/AW;	1 max
(ii)	disinfect surfaces (regularly) (use disinfectant/alcohol); wash hands, regularly/between patients; alcohol/antibacterial, hand wash/gel; medical staff wear hair nets; screen/regular nose swabs for, hospitalised patients/medical personnel; isolation of infected people; restricted visiting; replacement/sterilization, of bedding/surgical equipment; use disposable, gloves/overalls/aprons; correct disposal of above; education about measures/enforcement of measures; barrier nursing/suitably trained nurses; AVP; e.g. disinfect skin before surgery	2 max

[Total: 14]

**Mark Scheme 2803/01**  
**January 2007**

Question	Expected Answers	Marks
1 (a) (i)	5:1;	1
(ii)	7 [x smaller]/AW;	1
(b)	0.5;	1
(c)	surface area relative to volume too small/AW; diffusion too slow/AW; <i>idea of speed needed</i> distance too great/some cells deep in body/not all cells in contact with environment/AW; <b>R</b> <i>large if unqualified</i> insufficient/AW, oxygen/(named) nutrient, supplied/(named) waste removed; idea of linking (named) areas; <i>look for 'from...' 'to...' with an implication of organs, not just 'all over body'</i> (may be,) more (metabolically) active/AW/, homoiothermic; <b>R</b> <i>just 'need more energy'</i>	3 max
(d) (i)	alveolus/alveolar air, sac/space; <b>A</b> <i>alveoli/air sac</i> <b>A</b> <i>squamous epithelium</i>	1
(ii)	large surface area to volume (ratio)/AW; <b>R</b> <i>large area unqualified</i> thin/one cell thick, wall/short diffusion distance/AW; <b>A</b> <i>appropriate figures for width</i> squamous epithelium; permeable; blood supply, qualified; elastic tissue/recoil (after expansion); surfactant;	3 max
<i>error carried forward – mark (ii) independently. E.g. candidates who put 'capillary' in (i) – could still get points 1 to 4 in (ii)</i>		
		[Total: 10]

Question	Expected Answers	Marks
2 (a)	H; C/G; <b>A</b> <i>either or both</i> E; I; D; F;	6
		[Total: 6]





- (c) lower pp O<sub>2</sub> (at altitude);  
more/AW, red blood cells/haemoglobin;  
more/AW, oxygen transported to, muscles/muscle tissue;  
extra, cells/Hb, remain (for some time) on return to sea level/AW;  
(extra oxygen) allows aerobic respiration to continue longer (when exercising);  
reduces, lactate/lactic acid, production; **A** *delays oxygen debt*  
more/AW, ATP/energy, release; **R** *'making'/AW, energy*  
AVP; e.g. more carbon dioxide removal  
ref development of greater lung capacity  
EPO ref

**R** *references to change in heart size*

**4**  
**max**

**[Total: 15]**

Question	Expected Answers	Marks
4 (a) (i)	<u>potometer</u> ; R ' <i>transpirometer</i> '	1
(ii)	transpiration is the loss of water, <u>vapour/by evaporation</u> ; (apparatus) measures water uptake; to replace loss; assumes all uptake is lost/AW; ora some may be used explanation of how some uptake may be used e.g. used to regain turgor/used in photosynthesis; uptake by detached shoot may not be same as whole plant/AW;	3 max
(iii)	cut shoot under water/insert into apparatus under water/AW; cut shoot at a slant; no, airlocks/bubbles/AW in, plant/apparatus, <b>or</b> airtight/watertight, joints; dry off leaves/AW; use a healthy/undamaged/AW, shoot; <b>A</b> <i>fresh</i> allow time to acclimatise/AW; keep (named) condition(s) constant; <b>R</b> ' <i>control</i> ' conditions if unqualified measure per unit time; AVP; e.g. reference to scale, qualified – note position/fix scale <b>R</b> ' <i>set at 0</i> ' qualified reference to reservoir	4 max
	<b>R</b> <i>repeat readings – gives reliable results not valid readings</i>	

- (b) (i) 1 temperature increased;  
more KE/energy/AW;  
more evaporation/faster diffusion; **R** *transpiration* *max 3*
- 2 light (intensity) increased; **A** *sunlight* but **R** 'sun' but ecf  
stomata opened (wider);  
allowed more water vapour out/AW;  
*must be linked to stomatal point above*  
temp increase linked to light; *max 3*
- 3 humidity dropped/air less saturated/AW;  
internal spaces c. 100% saturated/AW;  
steeper water potential gradient/AW; **A** *diffusion gradient*  
**R** *concentration gradient* *max 3*
- 4 wind (increased);  
removed, saturated air/diffusion shells/AW;  
steeper water potential gradient/AW; **A** *diffusion* **R** *conc gradient*  
*max 3*

*Score the first two explanations given to a max of 4*

**4 max**

- (ii) 1 **P** has, many/more, leaves;  
(so total) area (of leaves) greater;  
(so) more, area for transpiration/evaporation/stomata;
- or**
- 2 **P** has more stomata;  
idea that stomata are (main) site/AW, of transpiration/evaporation;
- or**
- 3 **Q** has a stated xerophytic modification;  
**R** *Q is a xerophyte, if unqualified*  
**R** *Q has smaller/AW leaves*  
explanation of modification; needs how it reduces transpiration  
e.g. hairs – wind barrier/stops water vapour removal  
sunken stomata – traps water vapour/AW  
thick cuticle/wax/AW reduces loss/AW **R** *stops all loss*  
curled leaves – trapping water vapour idea

**2 max**

*Apply ora throughout.*

**[Total: 14]**

**Mark Scheme 2803/03**  
**January 2007**

**Planning Exercise**

The mark scheme for the planning exercise is set out on page 3. The marking points **A** to **T** follow the coursework descriptors for Skill P.

Indicate on the plans where the marking points are met by using a tick and an appropriate letter. There are 14 marking points for aspects of the plan and two marks for quality of written communication (QWC).

**Practical Test**

Pages 4 to 7 have the mark scheme for Questions 1 and 2 for the Practical Test.

## AS Biology. Planning exercise

Checking Point	Descriptor	The candidate
A	P.1a	Plans a suitable procedure that involves adding hydrogen peroxide to extracts of mung bean seeds and seedlings of different ages and measuring activity of catalase; <i>minimum of 2 samples of different ages</i>
B	P.1a	Gives a prediction involving activity of catalase over time (during germination and early growth);
C	P.1b	Selects suitable equipment and materials to include <b>three</b> of: apparatus to collect and measure gas [ <b>A filter paper discs</b> ], homogenising, measuring volumes, stopwatch;
D	P.3a	Gives the balanced chemical equation for reaction catalysed by catalase;
E	P.3a	Identifies at least <b>two</b> key factors to control, e.g. number/mass of beans; volumes, temperature, concentration of hydrogen peroxide, pH, duration of gas collection or reaction; <b>A factors to control during growth of beans</b>
F	P.3b	Decides on appropriate number of measurements to take: minimum of <b>five</b> different times during germination and early growth;
G	P.3b	Decides on an appropriate range of stages during growth, e.g. soaked seed to young plant with roots and leaves; <b>R 'days' alone</b>
H	P.3b	Describes ways of obtaining reliable results by including replicates, e.g. measurements from each growth stage repeated <i>at least once</i> ;
I	P.5a	Uses appropriate scientific knowledge and understanding in developing a plan, e.g. active site, complementary shapes, production of enzyme;
J	P.5a	Uses preliminary work or previous practical work in developing a plan;
K	P.5a	States a hazard and gives an appropriate precaution;
L*	P.5b	<i>Gives a clear account, logically presented with accurate use of scientific vocabulary (QWC);</i>
M	P.5b	Describes one way of obtaining precise results, e.g. using gas syringe, gas burette or other finely graduated container for gas collection, pressure sensor, standardising filter paper discs;
N	P.7a	Gives relevant information from any <b>two written sources</b> , e.g. class notes/text book/web site etc; <i>must be cited in plan</i>
O	P.7a	Shows how results are to be presented in the form of a table including units for age, volumes of gas/time; <b>R if units are in the body of the table</b>
P*	P.7a	<i>Uses spelling, punctuation and grammar accurately (QWC);</i>
Q	P.7a	Calculates a rate of reaction, e.g. by using gradients on time course graphs, volume of gas collected over certain period of time; <i>could be in a table</i>
R	P.7b	Explains how data would be interpreted to find answer to the investigation, e.g. plotting rate of reaction against age of plant; <i>graph must have labels</i>
S	P.7b	Justifies one way of obtaining precise results, e.g. justification of graduated container such as gas syringe, gas burette, etc;
T	P.7b	Explains that <i>initial</i> rate of reaction should be determined because substrate concentration decreases during reaction;

Point mark up to **14** by placing letters A to T, **excluding L and P** in the margin at appropriate

Question	Expected Answers	Marks										
1 (a)	<i>all correct for one mark – treat units in body of table as neutral</i>											
	<table border="1"> <thead> <tr> <th><i>substance tested</i></th> <th><i>glucose concentration/g 100 cm<sup>-3</sup></i></th> </tr> </thead> <tbody> <tr> <td>distilled water</td> <td>0,</td> </tr> <tr> <td>glucose solution</td> <td>1, <b>A</b> <i>any figure other than 0</i> ,</td> </tr> <tr> <td>fructose solution</td> <td>0,</td> </tr> <tr> <td>sucrose solution</td> <td>0;</td> </tr> </tbody> </table>	<i>substance tested</i>	<i>glucose concentration/g 100 cm<sup>-3</sup></i>	distilled water	0,	glucose solution	1, <b>A</b> <i>any figure other than 0</i> ,	fructose solution	0,	sucrose solution	0;	1
<i>substance tested</i>	<i>glucose concentration/g 100 cm<sup>-3</sup></i>											
distilled water	0,											
glucose solution	1, <b>A</b> <i>any figure other than 0</i> ,											
fructose solution	0,											
sucrose solution	0;											
(b)	<p>table format;  columns to show, contents/pH, colour and glucose concentration;  unit (g 100 cm<sup>-3</sup>) in heading; <b>R</b> <i>units in the body of the table</i>  colours recorded; <b>R</b> <i>'no change' unqualified by colour comment</i>  0 for <b>A</b> and <b>B</b>;  glucose present in <b>C</b>, <b>D</b> and <b>E</b>;  highest concentration in <b>D</b>;</p>	7										
(c) (i)	<p>control;  to ensure sucrose did not breakdown without enzyme/no non-enzymic  breakdown;</p>	max 2										
(ii)	<p><i>treat refs to 'optimum' as neutral</i></p> <p>equilibration/reach the same temperature/reaction occurs at same temperature  throughout/AW;</p>	1										
(d) 1	sucrose is, broken down/hydrolysed, to glucose (and fructose); <b>A</b> <i>equation</i>											
2	glucose detected in tube(s), <b>C/D/E</b> /with (unboiled/fresh) extract; <b>A</b> <i>ref to colour change in strips</i>											
3	no change with, distilled water/no extract/no enzyme;											
4	no change with boiled extract;											
5	boiling <u>denatures</u> enzyme(s)/AW;											
6	loss of shape of <u>active site</u> ;											
7	ref to results in different pH;											
8	activity/rate of reaction, influenced by pH; <b>A</b> <i>ref to optimum pH/pH affects enzymes</i>											
9	AVP;	max 6										



- (e) *descriptive comment to max 1*  
ref to optimum pH/extremes of pH; **A** a graph

correct ref to concentration of H<sup>+</sup>;  
change to (ionisation of some) R groups;  
ionic/hydrogen, bonds break;  
between (amino acid), R groups/side chains;  
tertiary/3 D, structure/shape, disrupted;  
shape of active site changes;  
not complementary to substrate; **A** *substrate does not fit*  
no/fewer, enzyme-substrate complexes formed;

*at extremes of pH*

(some) enzyme molecules(s), denatured/inactive;  
*idea that* all enzyme molecules are partly active;

AVP;

**max 5**

- (f) *idea that* sucrose broken down to glucose and fructose;  
fructose is also a reducing sugar;  
but not detected by Diastix/Diastix only tests for glucose;  
ref to result(s) in Table 1.1;  
*idea that* glucose oxidase is specific to glucose;

AVP; e.g.       reducing sugar concentration = 2 x glucose concentration  
                  explanation of specificity

**max 3**

- (g) (i)   sucrase, has carbohydrate side chains/AW; **A** *ref to sugars in structure*  
          **A** *different, active site/primary structure*  
          **A** *sucrase is branched*

**1**

- (ii)   sucrose is too large to pass though membrane; ORA for glucose/fructose  
       polar molecule/water soluble/not lipid soluble;  
       will not pass through (phospho)lipid bilayer;  
       no, channels/pores/carriers;  
       ref to movement of, glucose/fructose/monosaccharides, through carrier  
          molecules;

AVP;  
AVP;  
AVP;

*accept other plausible explanations and point mark accordingly*  
e.g.   *optimum pH for sucrase may not be same as cytoplasm*

**max 3**

**(h)** *limitations*

- 1 difficult to keep water bath at a constant temperature;
- 2 enzyme extract not added to tubes at exactly the appropriate time;
- 3 difficult to test with Diastix at same time intervals for the different tubes;
- 4 difficult to take readings *exactly* at 30 seconds;
- 5 difficult to, judge colours/match colours;
- 6 can only match to concentrations on colour chart/cannot give intermediate concentrations/AW;
- 7 only took one sample per tube/AW;
- 8 colour of strip changes after 30 seconds so cannot compare results overall;
- 9 only tested three values of pH;
- 10 no repeats/no replicates/should carry out repeats;
- 11 check for/ref to, anomalous result(s); **A** *ref to concordance of results*
- 12 did not check to see if buffer solution breaks down sucrose/AW;

*improvements*

- 13 use a thermostatically-controlled water bath;
- 14 run tests one at a time;
- 15 take results, every 30 seconds/more often/AW;
- 16 extend the time;
- 17 use a 'meter' to take measurements from Diastix (*cf* glucose biosensor);
- 18 use Benedict's, test/reagent;
- 19 Benedict's tests for glucose *and* fructose/Diastix only tests for glucose;
- 20 boil/water bath > 70 °C; **R** 'heat'
- 21 semi-quantitative described (use of colour comparators);
- 22 further detail; e.g. use of known concentrations for colour chart
- 23 use a quantitative test;
- 24 colorimeter;
- 25 filter and use filtrate;
- 26 use precipitate;
- 27 filter, dry and weigh precipitate;
- 28 calibration graph (for semi-quantitative *or* quantitative method);
  
- 29 use intermediate values of pH;
- 30 extend the range/< pH 2.2/> pH 8.0;
- 31 draw a graph of reducing sugar concentration against pH;
  
- 32 AVP; e.g. syringe not precise/use graduated pipette/use burette to measure volumes
- 33 AVP; e.g. glucose oxidase in Diastix influenced by pH

**R** 'no control'**max 10****[Total: 30]**

Question	Expected Answers	Marks
2 (a) (i)	tissue map of one vascular bundle without, cells/vessels; correct position of vascular bundle; correct size and shape; <i>slightly tapering towards centre of stem</i>	
(ii)	xylem in centre of vascular bundle; phloem on outside of vascular bundle; phloem on inside of vascular bundle;	6
(b)	<i>two marks for an appropriate answer even if no calculation shown ecf for correct method if measurement outside range</i>  measurement of width of sieve tube, divided by 450, converted to micrometres with answer to nearest micrometre  e.g. 0.035 (m)/3.5 (cm)/35 (mm)/35 000 ( $\mu\text{m}$ ), divided by 450; 78;  <b>A</b> 30 – 40 mm , 66 – 90 $\mu\text{m}$	max 2
(c)	thin walls; end walls/cross walls/sieve plates; luminal contents/cytoplasm present; sieve pores;	max 2
(d)	companion cells; contain <u>many</u> mitochondria; <i>must be linked with companion cell(s)</i> provide, ATP/energy; <b>A</b> <i>high rates of respiration</i> for <u>loading</u> of sucrose; active transport/pumping, hydrogen ions/protons, out of companion cells; return down gradient; through (carrier) protein; <i>idea of co-transport with sucrose;</i> plasmodesmata between (sieve tube elements and companion cells); <b>A</b> <i>pore</i> provide pathway/AW (for loading into sieve tube elements);  pressure build up in source; sieve tubes have living contents, suggests movement is active; <b>A</b> <i>phloem is living</i> mitochondria in sieve tubes; plasma/cell/cell surface, membrane, to keep in sucrose; sieve plates allow pressure gradient in sieve tubes;  AVP; e.g. ref to transfer cells with wall ingrowths	max 6

[Total: 14]



**Mark Scheme 2804  
January 2007**

Question	Expected Answers	Marks
1 (a) (i)	tree cut, close to ground/down to its stump/AW; <b>R</b> <i>down to trunk</i> new growth forms/AW; harvest after a number of years/process repeated; rotational coppicing/AW; ref to how coppicing increases biodiversity e.g. increasing light intensity;	max 3
(ii)	(standards) large planks/AW; <b>A</b> <i>used as timber</i> <b>A</b> <u>standards</u> <i>more valuable</i> /AW (coppice) small diameter wood/fencing/hurdles/garden furniture/charcoal/firewood/matches; (coppice) continuous, source of timber/income; recreational use/nature reserve; <b>A</b> ref to tourism	max 2
(b) (i)	eukaryotic; <b>A</b> <i>eukaryotic feature</i> heterotrophic; <b>R</b> <i>unable to photosynthesise</i> <b>A</b> <i>saprotrophic, parasitic</i> (hyphal/cell) <u>wall</u> of <u>chitin</u> ; (most made out of) hyphae; <b>A</b> <i>ref to mycelium</i> (reproduce by) spores; ref to <u>glycogen</u> stores; multinucleate/AW;	max 3
(ii)	eukaryotic/nucleus; membrane bound organelles/named membrane bound organelle; <b>A</b> <i>two named membrane bound organelles for 2 marks</i> <b>R</b> <i>chloroplast</i> (cell) wall; sessile/AW; <b>R</b> <i>reference to roots</i> (reproduce by) spores;	max 2
(iii)	release of carbon dioxide; from fungal respiration; available for photosynthesis/carbon fixation; extracellular digestion; named enzyme(s); release of, inorganic substance/minerals/named mineral; <b>R</b> <i>nutrients, nitrogen</i> <b>A</b> <u>nitrogenous compound</u> uptake through, <u>roots/root hairs</u> ; named use of mineral in plants; ref. to humus; ref. to beneficial role of humus in soil; e.g. increase water retention, improve soil structure, stabilize soil	max 4

[Total: 14]

Question	Expected Answers	Marks
2 (a) (i)	<u>sympatric</u> ;	1
(ii)	ranges of two species, overlap/close together/AW; no geographical barrier; ref to behavioural/genetic/physiological/prezygotic barrier; correct ref to named area of map;	max 2
(b)	ref to mate selection by size; ie large with large or small with small ref to monogamy; ref to intermediate sizes, at disadvantage/selected against/ora; intermediate do not pass on <u>alleles</u> /ora; suggested reason why intermediate at disadvantage/ora	max 3
(c)	female produces a lot of eggs; selects male, that can store lots of eggs/has a large pouch/ora; large males fertilise many eggs/ora; chance of more offspring surviving;  <b>or</b> large female and small male produce intermediates/ora; intermediates at disadvantage/ora;	max 2
		[Total: 8]

Question	Expected Answers	Marks
3 (a) (i)	<p>light absorbing/AW;  ref to excited electrons/AW;  used in light dependent stage;  ref. to location; e.g. chloroplasts, thylakoids, photosystems, grana, lamellae  AVP; e.g. (long) hydrocarbon chains,  different pigments absorb different wavelengths.</p> <p>(ii) high absorption of, wavelengths 450 – 480 nm/blue region of spectrum;  high absorption of, wavelengths 660 – 710 nm/red region of spectrum;  low absorption of, wavelengths 500 – 620 nm/green region of spectrum;</p> <p><i>for each marking point accept single figure in range. If candidate gives range it must fall within the range on the mark scheme.</i></p> <p><i>only penalise lack of units once.</i></p>	<p><b>max 3</b></p> <p><b>max 2</b></p>
(b)	<p>(primary) act as reaction centres/where electrons are excited;  (accessory) other part of photosystem/antenna unit/surround reaction centre;  (accessory) absorb different wavelengths of light (not absorbed by primary);  (accessory pigments) transfer <u>energy</u> to primary pigments;  names of primary (chl a, P680, P700) <u>and</u> accessory pigment (chl b, carotenoid);</p>	<b>max 2</b>
(c)	<p>1 <u>non-cyclic photophosphorylation</u>;  2 ref to photosystems 1 and 2 being involved; <b>A</b> PS1 and 2/P700 and P680  3 excited electrons emitted/AW;  4 ref to electron acceptor molecules;  5 (electrons pass along) chain of, electron carriers/ETC/cytochromes;  6 occurs in, thylakoid membranes/grana/lamellae;  7 sets up a, proton/H<sup>+</sup>/hydrogen ion/pH gradient; <b>A</b> <i>proton pump idea</i>  8 ref to ATP synth(et)ase; <b>A</b> <i>ATPase, stalked particle</i>  9 ref to, proton motive force/flow of protons;  10 chemiosmosis;  11 formation of ATP;  12 movement of electrons from PS2 to PS1;  13 ref to photolysis;  14 movement of electrons from water to PS2;  15 <u>cyclic photophosphorylation</u>;  16 PS1 only;  17 AVP; e.g. named electron acceptors, named electron carriers, ref. to water splitting enzyme, ref to position of photosystems.(PS1 intergranal membrane and PS2 grana)</p>	<b>max 8</b>

**QWC – clear well organised using specialist terms;**

**1**  
**[Total: 16]**



Question	Expected Answers	Marks
4 (a)	(i) <u>crossing over</u> ; <i>treat chiasma(ta) as neutral</i>	1
	(ii) <u>prophase</u> ;	1
	(iii) have different, alleles/base sequence of DNA; <b>A</b> <i>sister chromatids have same alleles/non sister have different alleles</i>	1
(b)	two different genes represented in each gamete ie Q or q <u>and</u> R or r; four correct combinations ie Q and R, Q and r, q and R, q and r;	2
(c)	(i) (parental genotypes:)      AaBb                      x                      aabb;	
	(gametes:)                      AB, Ab, aB, ab                      (all) ab;	
	(offspring genotypes:)      AaBb, Aabb, aaBb, aabb;	
	(offspring phenotypes:)      grey body/normal wing, grey body/bent wing, black body/normal wing, black body/bent wing;	
	<i>[sequence of phenotypes must match genotypes for mark]</i>	
(phenotypic ratio:)              1 : 1 : 1 : 1;		
	<i>apply ecf.</i>	
	<i>accept alternative symbols if a key is given, but if no key given max 4</i>	5
(ii)	80,80,80,80;	1
(iii)	(working) $0.1125 + 0.3125 + 0.05 + 0.45$ ; $= 0.925$ ; <b>A</b> <i>0.9/0.92/0.93</i>	
	<i>2 marks for correct answer with no working.</i>	
	<i>ecf if correctly use wrong figures from (ii)</i>	2
(iv)	yes ( <i>but no mark for yes on own</i> )	
	as calculated figure is smaller than 7.82;	
	<i>ecf applies to value calculated in part (iii)</i>	1

[Total: 14]

Question	Expected Answers	Marks
5 (a) (i)	removal of, carbon dioxide/carboxyl group; removal of hydrogen; <b>R</b> <i>H<sub>2</sub>/hydrogen molecules/hydrogen ions</i> <b>A</b> <i>H/2H</i>	2
(ii)	P and Q;	1
(b)	1;	1
(c) (i)	3; 1;	2
(ii)	1 <u>inner</u> mitochondrial membrane/cristae; 2 ref to (NADH) dehydrogenase; 3 hydrogen split into protons and electrons; 4 ref to, electron carriers/ETC/cytochromes; 5 energy released from electrons; 6 ref to protons pumped across membrane; 7 protons accumulate in intermembranal space; 8 proton gradient/pH gradient/H <sup>+</sup> gradient; 9 protons pass through ATPase; <b>A</b> <i>ATPsynthase/ATP synthetase/stalked particle</i> 10 ref. to oxygen (final) hydrogen/electron acceptor; 11 formation of water;	max 4
(d)	fats/fatty acids, not <u>respired</u> ; ref to ( $\beta$ -) <u>oxidation</u> (of fatty acids) requires NAD; NAD used in breakdown of alcohol; NAD is, limiting/in short supply/AW; fats formed from fatty acids plus glycerol; AVP; e.g. further detail of alcohol/fat metabolism	max 3

[Total: 13]

Question	Expected Answers	Marks			
6 (a)	(i) A	3	1		
	B	2			
	C	1;			
	(ii)	A		1 (voltage gated) sodium channels open; 2 sodium (ions) enter (axon); 3 positive feedback/more sodium channels open; 4 depolarisation/description of depolarisation; 5 sodium channels close; 6 ref to +40 mV;	
		B		7 (voltage gated) potassium channels open; 8 potassium (ions) move out (of axon); 9 positive feedback/more potassium channels open;	
				<i>only award marking points 3 or 9, not both</i>	
				10 repolarisation/description of repolarisation; 11 beyond -65 mV/hyperpolarisation/AW;	
		C		12 Na/K pump (helps to), restore/maintain, resting potential; 13 membrane more permeable to potassium ions (at resting potential); 14 (many) potassium channels open (at resting potential);	max 5
				(b) 1 sodium <u>ions</u> (inside axon), move/diffuse 2 towards, resting/negative region; 3 causes, depolarisation of this region/change of PD to reach threshold value; 4 (more)sodium channels open; 5 sodium (ions) move in;	
				<i>marking points 3-5 only available if linked to sodium ions moving within axon</i>	
				6 ref to local circuits; 7 one way transmission; 8 ref refractory period/region of axon behind AP recovering;	
				9 ref to insulating role of, myelin sheath/Schwann cells; 10 depolarisation cannot occur through myelin/impermeable to (Na <sup>+</sup> and K <sup>+</sup> ) ions/ora; 11 ref to nodes of Ranvier; 12 longer local circuits; 13 saltatory conduction/AW; 14 AVP; e.g. fewer (Na <sup>+</sup> and K <sup>+</sup> ) ion channels in myelinated region/ora. 15 AVP; ref. to absolute and relative refractory period, ref. to actual distance between nodes (1 – 3mm);	max 7
				<b>QWC – legible text with accurate spelling, punctuation and grammar;</b>	1

[Total: 14]

Question	Expected Answers	Marks
7 (a) (i)	due to mutation; <b>A</b> <i>named mutation</i> has changed, gene/allele/base sequence/DNA; random; irradiation/other named mutagen; genetically engineered; altered, mRNA/enzyme/protein; selective breeding;	max 2
(ii)	light <u>intensity</u> ; carbon dioxide; water/humidity; temperature; mineral content of soil/potting compost; <b>R</b> <i>nutrients</i> pH; lighting regime;	max 2
(b)	<i>wild type</i> no significant/very little, difference; those with water taller/ora; 18 day result an anomaly; ref to figures from table; <i>need two figures at same age with correct units</i>  <i>dwarf</i> those with gibberellin taller; difference greater as they get older; still shorter than wild type; ref to figures from table; <i>need two figures at same age with correct units</i>  <i>only penalise lack of units once</i>  calculation of % difference between treatments for either wild type or dwarf;	max 5
(c)	dwarf unable to produce (active) GA/ora; dwarf lacks enzyme for (active) GA formation/ora; details of why dwarf lacks enzyme; <b>A</b> <i>has, recessive/mutant allele</i>	max 2

[Total: 11]

**Mark Scheme 2805/01**  
**January 2007**

Question	Expected Answers	Marks
1 (a)	<i>male gamete</i> 17; <i>zygote</i> 34;	2
(b)	divides by mitosis; forms embryo; suspensor/basal cell; (growth of) plumule; (growth of) radicle; cotyledons; cotyledons may absorb endosperm; in <u>non-endospermous</u> seeds;	3 max
(c) (i)	releases/source of/provides/to give, energy; for germination; for growth/protein synthesis/spindle formation/organelle replication/ DNA replication/active transport/cell division/other named function;	2 max
(ii)	higher energy density/release twice as much energy per, g/unit mass; compared to, glucose/protein; 39 kJ g <sup>-1</sup> ; higher proportion of, hydrogen atoms/carbon-hydrogen bonds; advantage for dispersal/named advantage; AVP; e.g. ref to coenzyme A formation	2 max

**[Total: 9]**

Question	Expected Answers	Marks
2 (a) (i)	<p>microtubules labelled accurately;            9 + 2 arrangement of microtubules shown;            sections of at least two mitochondria shown and labelled accurately;            cell membrane shown and labelled accurately;</p> <p>(ii) <i>mitochondria</i>            closely packed/AW;            site of <u>aerobic</u> respiration;            (large amount of) energy/ATP, for movement;            AVP; e.g. relevant detail of, biochemistry/structure</p> <p style="text-align: right;"><i>max 2 for mitochondria</i></p> <p><i>axial filament</i>            (wave-like) beating of tail;            AVP; e.g. detail of microtubules/ref to contractile proteins</p>	<p>3 max</p> <p>3 max</p>
(b)	<p>p1 acrosome reaction;            p2 acrosome (in sperm head), swells/dissolves;            p3 acrosome and sperm head membranes fuse;            p4 enzymes released;            p5 hydrolytic/hydrolysis/described/AW;            p6 by exocytosis;            p7 large numbers work together;            p8 (digest path) through follicle cells/corona radiata;            p9 (another) enzyme digests path through zona pellucida;            p10 sperm head membrane fuses with oocyte membrane;</p> <p style="text-align: right;"><i>max 5 for acrosome reaction</i></p> <p>s11 cortical reaction;            s12 cortical granules/lysosomes;            s13 released by exocytosis;            s14 in (secondary) oocyte;            s15 zona pellucida thickens;            s16 separates from oocyte;            s17 ref to, fusion of membranes/fertilisation membrane;            s18 other sperm binding fall off/AW;</p> <p style="text-align: right;"><i>max 5 for cortical reaction</i></p> <p>19 AVP;</p>	<p>7 max</p> <p>1</p>

**QWC quality of organisation and use of scientific terms**

(c)

<i>condom</i>	✓	✗;
<i>vasectomy</i>	✓	✗;
<i>diaphragm</i>	✓	✗;
<i>combined pill</i>	✗	✓;

2 boxes correct for each marking point

4

(d)

(protein) binds to, membrane/ER/receptors;  
 complementary shapes of protein and receptor;  
 complex formed;  
 change shape;  
 calcium channels open;  
 diffusion/explained;  
 AVP; e.g. ref to vesicle formation

2 max

[Total: 20]



Question	Expected Answers	Marks															
3 (a) (i)	transfer of pollen from anther to stigma;	1															
(ii)	<table border="1"> <thead> <tr> <th></th> <th><i>adaptation to wind pollination</i></th> <th><i>adaptation to insect pollination</i></th> </tr> </thead> <tbody> <tr> <td><i>petals</i></td> <td>small/absent/green/inconspicuous</td> <td>large/conspicuous/ brightly coloured/scented/landing platform/honey guides</td> </tr> <tr> <td><i>stigma</i></td> <td>feathery/outside flower</td> <td>sticky/inside flower</td> </tr> <tr> <td><i>stamens</i></td> <td>outside flower/ swings freely/hinged</td> <td>inside flower</td> </tr> <tr> <td><i>pollen</i></td> <td>light/small/smooth/ large amount</td> <td>rough/sticky</td> </tr> </tbody> </table>		<i>adaptation to wind pollination</i>	<i>adaptation to insect pollination</i>	<i>petals</i>	small/absent/green/inconspicuous	large/conspicuous/ brightly coloured/scented/landing platform/honey guides	<i>stigma</i>	feathery/outside flower	sticky/inside flower	<i>stamens</i>	outside flower/ swings freely/hinged	inside flower	<i>pollen</i>	light/small/smooth/ large amount	rough/sticky	
	<i>adaptation to wind pollination</i>	<i>adaptation to insect pollination</i>															
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<i>stamens</i>	outside flower/ swings freely/hinged	inside flower															
<i>pollen</i>	light/small/smooth/ large amount	rough/sticky															
	<i>any two boxes correct for each marking point</i>	4															
(b) (i)	anthers mature before stigma/pollen released before stigma mature; stigma cannot pick up pollen of same plant/AW/ora;	1 max															
(ii)	pollen more likely to be blown by wind; carried to distant plants/AW;	1 max															
(iii)	pollen carried, to other plant/between adjacent plants/AW; one flower does not have pollen and stigma/insect cannot collect pollen and pollinate same flower/AW; AVP; eg incompatibility of male and female	1 max															
(c)	<i>assume cross-pollination unless told otherwise</i> prevents inbreeding/form of outbreeding/hybrid vigour; <u>increase in genetic variation</u> ,/diversity; phenotypic variation/AW; advantage, in new/changed, environment; evolution/natural selection more likely to occur; not all wiped out by disease; recessive alleles less likely to be expressed/AW; AVP;	2 max															
(d) (i)	embryo sac;	1															
(ii)	through stigma, style, micropyle;	1															

[Total: 12]

Question	Expected Answers	Marks
4 (a)	ranges overlap; age of onset of menopause varies; from 43 to 56 years/mean age stated; AVP;	2 max
(b)	1 ref. to figs. using relevant data from table and graph; 2 oestrogen levels fall; 3 less oocytes available/less primordial follicles remain; 4 follicles/oocytes, less likely to develop; 5 less oestrogen secreted, by oocytes/follicles; 6 follicles less sensitive to FSH; 7 FSH levels increase after menopause; 8 inhibition by oestrogen; 9 lost as oestrogen declines/AW; 10 negative feedback; 11 as inhibition lost, FSH levels rise; 12 AVP; e.g. oestrogen cannot inhibit FSH below a critical level	5 max
(c)	oestrogen antagonistic to parathormone; as oestrogen levels fall, parathormone levels rise; (stimulates) raising of blood calcium levels; calcium removed from bones; loss of bone mass/low bone density; lack of oestrogen diminishes osteoblastic activity; decreases bone matrix; decreases deposition of calcium phosphate in bone;	3 max
(d)	risk of CHD/stroke/DVT/heart attack; fatty material accumulates, in (walls of) arteries/plaques/atheroma; nicotine/carbon monoxide, causes plaques; increase fibrinogen production/increased cholesterol concentration; platelets become sticky; blood flow restricted/blood clots restrict flow further/infarction; in coronary/femoral/cerebral, artery/other named, blood vessel AVP; e.g. multifactorial disease AVP; e.g. role of cholesterol e.g. synergistic/AW e.g. effect of nicotine on, heart rate/oxygen requirements of heart muscle	4 max

[Total: 14]

Question	Expected Answers	Marks
5 (a)	<p><i>assume stem cells unless told otherwise</i></p> <p>no (cellulose) cell wall;  no vacuoles;  contains centrioles;  AVP; e.g. ref. to difference in sizes of cells</p>	1 max
(b) (i)	<p><b>R questions</b></p> <p>embryo, potential human/member of society/right to life/killed/AW;  may be from abortion;  scientist making decision for use of embryo/consent may not be required;  parents may not know fate;  religious objection;  may involve cloning;  some stem cells can be obtained instead from umbilical cord;  AVP;</p>	1 max
(ii)	<p>treat/cure for, anaemia/sickle cell anaemia/named blood disease;  blood, for transfusion/to replace loss;  treat, immune disorders/SCID/lupus;  treat, non-Hodgkins lymphoma/some types of cancer/leukaemia;  treat/cure for, Alzheimer's disease;  treat/cure for, Parkinson's disease;  treat paraplegics/repair injury to, nerves/spinal cord;  treat, genetic disorders affecting nerves/Huntington's/Tay Sachs/Lou Gehrig's;  treat multiple sclerosis/motor neurone disease;  AVP; eg. stroke/brain damage/retinal repair  AVP; <i>must be relevant to use of blood cells or neurones</i></p>	2 max
(c) (i)	<p>formed from one sperm and one oocyte;  <u>genetically</u> identical;  all inherited features identical/AW;</p>	1 max
(ii)	<p>one placenta, more efficient/better blood supply/ora;  one twin obtains more nutrients/ora;  better oxygen supply to one twin;  competition for, space/position, in uterus;  time interval between births;  disease in one twin;  AVP; e.g. pressure on one umbilical cord  AVP;</p>	2 max

- (d) *alcohol consumption*
- A1 fetal alcohol syndrome/FAS;
  - A2 slows brain development/AW;
  - A3 poor muscle tone;
  - A4 heart defects;
  - A5 abnormal limb development;
  - A6 certain facial characteristics/upturned nose/cleft palate/receding chin;
  - A7 AVP; e.g. teratogenic drug/affects genes controlling development/  
dependent on alcohol
- max 4 for alcohol*
- allow 1 max for effect of vitamin deficiency not related to named vitamin*
- vitamin A*
- V8 malformation/underdeveloped eyes;
  - V9 immune system underdeveloped/AW;
  - V10 epithelial cells, not produced/not maintained/not differentiated/linked to  
cancer;
  - V11 AVP; e.g. poor development of brain
- vitamin D*
- V12 calcium not deposited in bone;
  - V13 abnormal bone development/weak bones;
  - V14 AVP;
- vitamin B1/B2/B3*
- V15 reduced/less efficient, cell respiration;
  - V16 less energy available;
  - V17 AVP; e.g. sterility/heart defects/nerve damage
- vitamin C*
- V18 poor iron absorption in mother leading to less iron for fetus/AW;
  - V19 reduced connective tissue/AW;
  - V20 AVP; e.g. detail of collagen formation
- folic acid*
- V21 reduced formation/large irregular shape, of red blood cells;
  - V22 reduced oxygen transport;
  - V23 spina bifida/neural tube defects/cleft palate/learning difficulties/eye and ear  
defects;
  - V24 AVP; e.g. ref to need before conception;
- max 4 for vitamins*
- general points*
- G24 reduced growth/low birth mass;
  - G25 death of fetus/miscarriage/stillbirth;

[7]

**QWC – legible text with accurate spelling, punctuation and grammar**

[1]

**[Total: 15]**

Question	Expected Answers	Marks
6 (a) (i)	binary fission; DNA replicates; mitosis; membrane forms/cytokinesis; two cells produced; genetically identical/clones;	2 max
(ii)	one parent only required/no need to find a mate; no gametes/no energy wasted producing gametes; large numbers of offspring/rapid reproduction; spreads (quickly) before destroyed by host immune system/AW; AVP; e.g. retain, advantageous alleles/adaptation to environment	2 max
(b)	hydrolysis (of Hb); by enzymes; proteases; breaks peptide bonds; removal of haem group; reference to, diffusion/active transport/pinocytosis/channel proteins; AVP;	3 max
(c) (i)	indicates the range of results; on either side of the mean; indicates, variability/(standard) deviation/(standard) error; indicates if data sets significantly different;	2 max
(ii)	no/small, increase/figs. quoted; lag phase; adjust to conditions/detail of adjustment; produce enzymes; AVP;	2 max
(iii)	more rapid growth in non-deficient cells/ora; figures in support from both axes of graph; low ribose in G6PD deficient cells/ora; less available to, parasites/ <i>Plasmodium</i> ; less production of RNA/ribonucleotides; less available for transcription; inhibited protein synthesis; less protein available for, reproduction/growth/cell division;	4 max
(d)	prevents osmosis; no net movement of water/AW; prevents bursting/lysis/crenation/AW;	2 max

- 6 (e) deficiency gives resistance to malaria;  
deficient/resistant, individuals more likely to survive;  
alleles, passed to next generation;  
natural selection;  
presence of *Plasmodium* is selection pressure;  
frequency of this allele increases;  
phenotype more common in population;  
AVP; e.g. others more likely to die of malaria

**3 max**

**[Total: 20]**

**Mark Scheme 2805/02**  
**January 2007**





Question	Expected Answers	Marks
2 (a) (i)	for benefit of humans; to improve, trait(s)/named trait; to produce desirable, phenotype/genotype; to increase number of desirable alleles; to increase homozygosity; AVP;	max 2
(ii)	ref. self-pollination; ref. inbreeding; limited gene pool;	max 2
(iii)	ref. different numbers of chromosomes; hybrid is 3n; sterile; gametes have 22 and 11 chromosomes/hybrid has 33 chromosomes; some chromosomes unpaired; failure of meiosis; ref. uneven distribution of chromosomes; ref. other barrier to interspecific cross;	max 2
(b)	meristematic/pluripotent/totipotent/cambial/undifferentiated , tissue; sterile conditions; nutrient medium to encourage, division/mitosis; produces <u>callus</u> ; subdivided; different (nutrient) medium to encourage differentiation; detail of either medium; e.g. <i>named nutrient or plant growth substance</i> grows to <u>plantlet</u> ; hardening medium/sterile soil;	max 5
(c)	stated advantage; detail; e.g. <i>particular character (not whole phenotype)/can alter one trait only (without affecting background genes)/can add allele from different taxon with which breeding may not be possible/quicker (than the many generations of, selective breeding/backcrossing)</i>	2
	stated disadvantage; detail; e.g. <i>cannot precisely position insert (so) unknown/unanticipated effect/may pass to other species (with unknown/undesirable, effect)/regarded as ethically undesirable (no market/crop destroyed by protesters)/cannot breed from GM (requires cloning)</i>	2

[Total: 15]

Question	Expected Answers	Marks
3 (a) (i)	protein in outer layer of bilayer/protein spanning bilayer; with amino acids with R groups with negative charge; ref. ionic/acidic/COO <sup>-</sup> /aspartic acid/glutamic acid;	2
(ii)	ref. immune response; ref. antigen(s); may attack, oocyte/sperm; because, oocyte foreign/either haploid; ref. infected white cells; e.g. <i>HIV</i>	max 2
(b)	liquid nitrogen/-196° C; buffer/ref. citrate/extender medium; 'straws'/description;	max 2
(c)	<i>advantages:</i> 1 one male can inseminate many females; 2 speeds up, selective breeding/progeny testing; 3 allows use of different males to avoid inbreeding/avoids inbreeding from only having one male available; 4 allows use of, high class/AW, sire; 5 avoids, cost/problems, of keeping male; 6 avoids, need for animal to travel/stress to animal of travel; 7 avoids, stress of/damage during, mating; 8 available, easily/quickly/at any time; 9 available at a distance/internationally; 10 available after death of male; 11 sperm can be, screened/genetically tested/sexed; 12 AVP;	max 5
	<i>disadvantages:</i> 13 unnatural so lack of respect for animal; 14 storage may damage sperm; 15 requires, training/expertise; 16 cost; 17 particular sire may be used too often so, inbreeding/reduced gene pool; 18 much used sire may have unknown genetic fault; 19 AVP;	max 8
	<b>QWC - legible text with accurate spelling, punctuation and grammar</b>	1

[Total: 15]

Question	Expected Answers	Marks
4 (a)	<p>increased homozygosity/decreased heterozygosity;  loss of alleles;  loss of variation/genetic erosion/decreased gene pool;  deleterious recessive alleles, expressed/homozygous/accumulate;  inbreeding depression;  eg of same; e.g. <i>loss of fertility/vigour</i>  loss <u>hybrid vigour</u>;</p>	4
(b) (i)	<p><b>x</b>;  <b>x</b>;  ✓ (tick);  <b>x</b>;</p>	4
(ii)	<p>discontinuous; [<i>do not allow if no reason given</i>]</p> <p><i>reason</i>  one, gene/locus; <b>A major/Mendelian, gene</b>  discrete phenotypes/ora;  qualitative/large effect/little environmental effect;</p>	1
(c)	<p>S<sub>1</sub> pollen is incompatible/S<sub>2</sub> pollen is compatible;  low percentage/2 - 4 %, DNA fragmentation in S<sub>2</sub> in all conditions;  stigma proteins activate E in S<sub>1</sub> pollen;  3% to 72%;  active E fragments 72% DNA vs. inactive E 19%;  E not completely inactivated by inhibitor;  inhibitor competitive;  ref. damage never 0%;  yes, E responsible;  E may, not be only cause of damage/be active even in compatible pollen;</p>	max 5

[Total: 15]

Question	Expected Answers	Marks
5 (a) (i)	<p>increased percentage resistant as erythromycin used more initially; to almost 20%/19%; <u>natural selection</u>; erythromycin is selective agent; resistance is selective advantage/selective pressure for resistance; resistants survive and pass mutation to offspring; peaks 1993 after drop in erythromycin use; peaks of doses and resistance not coincident; fall to 15% in '94; less erythromycin use since 1988/peak use 1988; selective pressure reduced but not zero; resistance still has selective advantage;</p>	max 4
(ii)	<p>gene mutation; random; change in DNA, base code/triplet code; addition/deletion/substitution; vertical transmission;</p> <p>acquiring R plasmid; by, conjugation/horizontal transmission; from same or different species; by, transformation/transfer from (bacterio)phage;</p>	max 2
(b) (i)	<p>endonuclease; cuts DNA; with sticky or blunt ends; at, palindromic/AW/specific/4 to 6 base pair/restriction, site; from bacteria; for cutting <u>phage DNA</u>;</p>	max 3
(ii)	<p>2 sources DNA; ref. sticky ends; complementary binding; H-bonds between bases; A to T and C to G; nicks in sugar-phosphate backbone sealed/AW; by ligase;</p>	max 4

[Total: 15]

Question	Expected Answers	Marks
6 (a)	<p><i>Symptoms</i></p> <p>1 transport of Cl<sup>-</sup> and water disrupted/ref. CFTR/ref. ion pump/AW;  2 dehydration of mucus;  3 thick/AW, mucus builds up in, airways/lungs;  4 substrate for bacterial growth;  5 (bacterial) infections occur;  6 repeated, infections/coughs, scar lungs;  7 reduces SA for gas exchange;  8 mucus builds up in gut;  9 blocks secretion of enzymes from pancreas;  10 malnutrition/reduced, digestion/absorption;  11 blocks, sperm duct/vas deferens, so infertile;  12 reduced life expectancy;  13 AVP;</p> <p><i>Gene therapy</i></p> <p>14 normal allele is dominant/mutant allele recessive;  15 addition of dominant allele to affected cells would be expressed;  16 no need to, remove/inactivate, recessive/mutant, allele;  17 can be delivered by vector into airways;  18 vector is liposomes/virus; <b>A nanoparticles</b>  19 problem with virus re, immunity/inflammation;  20 allele may insert anywhere;  21 treatment must be constantly repeated; <b>A not permanent/temporary</b>  22 because airway cells shed;  23 limited success so far;  24 AVP;</p> <p><b>QWC - clear well-organised answer using specialist terms</b></p>	<p>4 max</p> <p>4 max</p> <p>8</p> <p>1</p>
(b) (i)	<p>two recessive alleles/homozygous recessive/two of allele 2;  no, normal dominant/allele 1;  homozygous same allele as affected child;</p>	2
(b) (ii)	<p>deletion removes base pairs;  shorter/lighter, pieces of DNA move further in electrophoresis;  towards anode;  so allele 2, shorter/lighter, than allele 1;</p>	max 3
(c)	0.25/25%/1 in 4;	1

[Total: 15]



**Mark Scheme 2805/03**  
**January 2007**

Question	Expected Answers	Marks
1 (a)	<p><b>Description</b></p> <p>egg shell thinning in birds of prey;</p> <p>accumulation in fatty tissues;</p> <p>accumulation in food chain;</p> <p>insects develop resistance leading to selection as a result of mutation;</p> <p>damage to ecosystems;</p> <p>AVP; ref to humans and explanation, e.g. asthma and neurological effects</p>	<p><b>Explanation</b></p> <p>accumulated higher up food chain and caused physiological effects;</p> <p>DDT is fat soluble;</p> <p>not metabolized in body and stays in fatty tissue/AW;</p> <p>overuse of DDT/treadmilling;</p> <p>prolonged toxicity of chemical;</p>
(b)	<p>persistent chemical/AW;</p> <p>builds up in food chains;</p> <p>still used in other parts of the world; (and so can still enter ecosystems)</p> <p>ref to global cycling;</p> <p>AVP;</p>	<p><b>max 4</b></p> <p><b>max 2</b></p>
(c)	<p>to remove weeds from crops to <u>increase yield</u>/AW;</p> <p>ref to decreased competition (in crops)/AW;</p> <p>quicker and cheaper (than using labourers);</p> <p>ref to size of target species;</p> <p>ref to specificity of insecticides/ora;</p> <p>ref to validity of data in study/ref to comparative data;</p> <p>AVP;</p>	<p><b>max 3</b></p>
(d)	<p>Tau-fluvalinate;</p> <p>less needed/ref to data with correct units;</p>	<p><b>max 2</b></p>
(e)	<p>ref to, leaching/runoff, into waterways;</p> <p>causing algal blooms;</p> <p>blocking of light for aquatic plants;</p> <p>ref to, decomposition/high numbers of decomposers;</p> <p>leading to high BOD;</p> <p>reference to 'blue-baby' syndrome;</p> <p>links to haemoglobin;</p>	<p><b>max 4</b></p>

**[Total: 15]**



Question	Expected Answers	Marks
2 (a)	$(80 \times 38)/17 = 179$ ;	max 2
(b)	ref to use of anesthetic/stun insect in a way not to damage it; paint the insect in an inconspicuous place; mark all moths in a similar way; use a cellulose based paint/AW;	max 2
(c)	no migration/emigration/immigration; no births/deaths; populations released freely mix; adequate time between sampling; marked individuals unaffected by procedure/not damaged; ref to survival/predation or behaviour; the marks will not come off between sampling; AVP;	max 4
(d)	1 ref to setting grid/area to be sampled; 2 suitable systematic method chosen/ref to belt/line transect; 3 ref to repetition of line transects; 4 use of <u>quadrats</u> ; 5 use of appropriate sized quadrat; 6 details of <u>regular</u> quadrat placing;  7 identify species/use of keys; 8 presence or absence in quadrat; 9 calculation of % of species frequency; 10 measure % cover/use of appropriate scale; e.g. (Braun-blانquet/ACFOR/ DAFOR/DOMIN) 11 ref to analysis of data/use of kite diagram; 12 AVP; ref to relevant statistical analysis, e.g. Spearmans Rank Correlation	max 7
	<b>QWC - clear well-organised answer using specialist terms</b>	1

[Total: 16]

Question	Expected Answers	Marks
3 (a)	large area of land required; costs are minimal/AW; lower levels of productivity/annual yield; low quality grazing; natural recycling of waste/nutrients; land had little or no fertiliser added; ref to low stock density AW; AVP; e.g. named example, such as upland sheep	max 4
(b)	steep rise from 1988 to 1992; peak of just over 31,000 cattle in 1992; steep decline after 1992; steady decline from 1997 to 2004; comparative paired data quote;	max 3
(c)	disease spreading rapidly through a population; affects a large number of individuals;	max 2
(d)	possibility of passing on the infection to humans; removal of all infected products from the food chain; reassurance to the general public;	max 2
(e)	grazing animals removing plant species; ref to trampling; prevention of climatic climax community reached; ref to named example e.g. woodland; plagioclimax reached; definition of deflected succession/ref to species composition; AVP;	max 4
<b>[Total: 15]</b>		

Question	Expected Answers	Marks
4 (a)	<p><i>viability</i>  ensure that seeds are germinated from time to time;  collect new seeds produced;  ref to suitable storage conditions;</p> <p><i>variability</i>  ensure that you have many seeds;  collect seeds from different areas;  ref to mixture of genotypes;</p>	2 max
(b)	<p>presence of disease resistant genes;  ref to artificial selection;  ref to maintenance of gene pool;  important for evolution/extinction of species/AW;</p>	max 3
(c)	<p>enzymes stop working;  no hydrolysis;  no germination of seeds/testa does not split;  no stimulation of gibberellins/named enzymes;  stops fungal rot;  ref to prevents disease and infection;  AVP;</p>	max 2
(d)	<p><i>Management problems</i></p> <ol style="list-style-type: none"> <li>1 capture of species/AW;</li> <li>2 numbers of species caught ref to extinction;</li> <li>3 ref to named example e.g. elephants;</li> <li>4 maintenance of genetic variability/gene pool;</li> <li>5 ref to funding;</li> <li>6 ref to species ownership/AW;</li> <li>7 problems of storage and maintenance;</li> <li>8 ref to specific example of problem; e.g. inbreeding/altered breeding/seed preparation;</li> <li>9 AVP;</li> </ol> <p><i>Need for success</i></p> <ol style="list-style-type: none"> <li>10 stop extinction/maintain gene pool;</li> <li>11 potential medical benefits;</li> <li>12 agricultural benefits/artificial selection;</li> <li>13 named example of crop improvement;</li> <li>14 ethical/moral responsibility for future generations;</li> <li>15 AVP;</li> </ol>	3 max
	<b>QWC - legible text with accurate spelling, punctuation and grammar</b>	<b>1</b>

[Total: 15]

Question	Expected Answers	Marks
5 (a)	routeways/pathways allowing movement of (insects); ref to connectivity/AW; ref to sites of refuge/habitat;	<b>max 2</b>
(b)	increase in aphid population (from week 1 to week 4) due to lower predator numbers; steady increase of ladybirds (from 1.5 weeks to 6 weeks) due to increase in, prey/availability of food; rapid decline in aphid numbers (from 4 to 7 weeks) due to predation; rapid decline in ladybirds (from week 6 to week 8) due to lack of food/prey; descriptions of lag phases; neither curve reaching extinction; explanation for this; ref for cyclical pattern; always more prey than predators;	<b>max 5</b>
(c)	pest remains/not totally eradicated; slow to work/AW; labour intensive/AW; reintroduction often needed; predator may eat crop; risk of migration; risk to other organisms/mutation/predation of other species;	<b>max 2</b>
(d)	pollination; maintain biodiversity; benefits to food chain/food for other organisms;	<b>max 2</b>
(e)	increased profit for farmers/shops; no residues on food; no pesticides; less use of inorganic fertilizers; less risk of pollution; benefits to soils structure and quality; benefits to biodiversity; benefits to human health;	<b>max 3</b>

**[Total: 14]**

Question 6	Expected Answers	Marks
(a)	use of drift nets; sonar/satellite detection; fleet vessels able to stay at sea for longer periods; fish processed at sea; increase operational radius of boats;	max 2
(b)	over-fished in 1990 causing population crash in 1991/AW; catch in 1991 may have included juvenile fish/AW; more fish returned/smaller in mass overall; enforced quota in 1991; market changes/AW; e.g. switch to other species AVP; e.g. ref to disease	max 2
(c)	effects on food chain/web; ref to loss of species biodiversity; decreasing reproduction rates leading to decrease in population size; ref to removal of reproductive adults; ref to nutrient recycling/abiotic factors; ref to alteration of habitat; ref to named example; AVP;	max 5
(d)	precise scientific counts for fish species; setting of minimum mesh sizes; size of net; regulation of fish size landed; stopping fishing during breeding seasons/sites; restrictions on time at sea; restrictions on size of fleet;	max 2
(e)	position of farm/damage to existing ecosystems; costs of chemicals/pesticides/hormones/antibiotics; risk of pollution; risk of eutrophication; risk of fish lost to disease; risk of escapees and effects on natural populations; management review of farm; AVP;	max 4

[Total: 15]



**Mark Scheme 2805/04  
January 2007**

Question	Expected Answers	Marks
1 (a) (i)	<p><i>product</i>                      <i>starter culture</i>                      <i>type of microorganism</i>                      <i>main carbohydrate/sugar source</i>                      <i>type of fermentation</i></p> <p>beer/lager/wine; A alcohol/ethanol</p> <p><i>Penicillium</i>; A <i>P. notatum</i> A <i>P. chrysogenum</i></p> <p>lactose;</p> <p><i>Fusarium</i> A <i>F. graminearum</i></p> <p>(unicellular) fungus /yeast; R filamentous fungus</p> <p>batch;</p> <p>(filamentous) fungus; continuous;</p>	8
(ii)	<p>ref. to application/use of/AW, (living) organisms/biological systems/AW; R ref to <i>microorganisms alone</i> to make products of, value/use/AW; AVP; e.g. named example incorporating both elements</p>	max 2
(b) (i)	<p>steam (sterilised); AVP; e.g. scrubbed with disinfectant</p>	max 1
(ii)	<p>may provide oxygen; for, aerobic respiration/aerobes; allows mixing of, culture/cells, and nutrients/AW; R <i>mix contents</i> helps to dissipate/AW, heat; if anaerobic supply, carbon dioxide/nitrogen; carbon dioxide for photosynthetic organisms; ammonia for, nitrogen source/mycoprotein production; AVP; e.g. allows mixing when, stirrers/paddles can't be used/cells delicate</p>	max 3
(iii)	<ol style="list-style-type: none"> <li>1. ref. to contamination (of culture or product);</li> <li>2. (bacterio)phages;</li> <li>3. ref. to, infect <u>bacterial</u> culture/kill <u>bacteria</u>;</li> <li>4. ref. to pathogens/named pathogen/named type of pathogen;</li> <li>5. risk to consumer, of <u>disease/infection</u>;</li> <li>6. competition for resources;</li> <li>7. increased depletion of nutrients/AW;</li> <li>8. ref. to production/release, of metabolic/toxic products;</li> <li>9. ref. to possible harmful effect on consumer;</li> <li>10. impaired, flavour/quality, of product/AW;</li> <li>11. reduction in numbers of (culture/fermenter) organism;</li> <li>12. lower yields/decreased productivity/AW; <i>linked to any relevant point</i></li> <li>13. ref. to, loss of batch/halted process/wasted product/AW;</li> <li>14. AVP; e.g. financial loss, qualified</li> </ol>	



Question	Expected Answers	Marks
2 (a) (i)	synthetic;	1
(ii)	<i>one mark for each</i>	
	<p><i>ammonium nitrate</i>  any valid; e.g.  <i>(provide nitrogen for)</i>  amino acids/proteins/polypeptides  bases/nucleotides/nucleic acids/DNA/RNA  ATP  chlorophyll structure  coenzyme</p>	
	<p><i>magnesium sulphate</i>  any valid; e.g.  <i>(provide magnesium for)</i>  chlorophyll structure <b>R</b> <i>chloroplast</i>  cofactor (for enzymes)  ref. to ribosomes/translation</p>	<p><i>(provide sulphur for)</i>  amino acids/proteins/  polypeptides  vitamins/thiamine/biotin  coenzymes</p>
	<p><i>potassium dihydrogenphosphate</i>  any valid; e.g.  <i>(provide potassium for)</i>  enzyme activator/cofactor  protein synthesis</p>	<p><i>(provide phosphate for)</i>  ATP  DNA/RNA/nucleotides/nucleic  acids  membrane structure/  phospholipids</p>
		3

- (b)
1. use colorimeter/turbidity meter/spectrophotometer;
  2. agitate/mix, culture (to disperse cells evenly)/AW;
  3. ref. to method of removing samples e.g. syringe, dropper;
  4. ref. to/description of, aseptic technique;
  5. ref. to removal of samples at same time of day;
  6. sample added to cuvette;
  7. use of blank/reference, to set to 0 (absorbance);
  8. description of blank e.g. culture medium with no organisms; **R** *distilled w*
  9. use of filter/suitable wavelength;
  10. obtain absorbance/optical density/transmission reading;
  11. high absorbance/low transmission = high turbidity;
  12. ref. to absorbance/turbidity being proportional to population density;
  13. AVP; e.g. samples, of constant volume/filled, to mark/arrow/with  
4 cm<sup>3</sup>  
use of replicates  
detail of correct use of cuvette

*credit acceptable alternative method*

**max 5**

- (c) *justified*  
maintains same/constant conditions (competition for space, nutrients); ora  
otherwise number of organisms is less and will affect following (density)  
readings;  
maintains volume of medium;  
otherwise may reduce volume to 0 before investigation is complete; AW

*not justified*

introduces possibility of contamination;  
(contaminants) may affect following (density) readings;  
sample removed not subject to same conditions of growth throughout;  
unlikely to be able to re-introduce the same volume as removed;

**max 2**

- (d) (i) **A** lag;  
**B** log/exponential/rapid growth;

**2**

- (ii) *accept these mark points once only in (ii) or (iii)*  
population/number of cells, reaches a plateau/levels off/AW;  
correct data ref: e.g. turbidity remains at 1.12 au;

log phase does not continue/stationary phase reached/absorbance does not  
keep increasing/AW;  
no nutrients added during the culture/all nutrients added at beginning;  
conditions not controlled/optimum conditions not maintained;

**max 2**

- (iii) rate of increase in, turbidity/population growth, slows down/decreases;

**A** *deceleration/linear phase*

(time when) number of new cells produced equals/balanced by, numbers of cells dying;

correct data ref e.g. from 5 to 8.5/9 days (deceleration), from 8.5/9 to 11 days (stationary)

individual cells, metabolic rate/growth slows;

nutrients, exhausted/depleted; **R** *glucose/respiratory substrate*

waste products accumulate;

pH decreases;

CO<sub>2</sub> depleting;

ref. to overcrowding/shading/lack of light;

ref. to all dead towards the end;

AVP;

**max 3**

- (iv) stationary phase/phase C could begin between readings/AW;

ref. to turbidity readings total count;

ref. to difficult to ascertain living and dead cells;

AVP;

**2**

**[Total: 20]**

Question	Expected Answers	Marks
3 (a)	<p><i>fusogen</i> causes, fusion of cell membranes/membranes of cells to join; (eg) polyethylene glycol/ethane-1,2-diol; <b>A</b> PEG (chemical) used for, forming hybridoma cells/hybridisation/fusion of lymphocyte and myeloma cell; <span style="float: right;"><i>max 1</i></span></p> <p><i>hybridoma</i> cell formed from fusion of myeloma/tumour/immortal cell and lymphocyte/ splenocyte; cell containing, genes/genetic material/DNA, from lymphocyte and myeloma cell; ref. to two features e.g. cell that can, secrete antibodies, divide/be cloned, be cultured in a fermenter, exhibit rapid growth <span style="float: right;"><i>max 1</i></span></p> <p><i>clone</i> <i>accept reference to single cell in the right context</i> group of genetically identical cells; <b>R</b> <i>organisms alone</i> cells producing the same monoclonal antibody; cells descended (asexually/by mitosis) from the same, ancestor/hybridoma/ <u>B</u> lymphocyte cell; <span style="float: right;"><i>max 1</i></span></p>	<b>max 3</b>
(b) (i)	transducer/3 down	<b>1</b>
(ii)	phage/2 down;	<b>1</b>
(c) (i)	<p>ref. attachment;</p> <p>contains enzyme/glucose oxidase; attachment to (biological) recognition layer; ref. to specificity/binding of enzyme to glucose molecules;</p> <p>(monoclonal) antibody bound to (surface coating of), dipstick/strip/window/AW; ref. to specificity/binding, of monoclonal antibody to HCG/of antibody-HCG complex to immobilised antibody; ref. to control, line/window, of immobilised antibodies; <span style="float: right;"><b>3</b></span></p>	
(ii)	<p>ref. to diabetics, unable/need to, control (blood) glucose concentrations;</p> <p>biosensors to monitor <u>blood</u> glucose concentrations; ref. to importance of rapid/accurate/quantitative results for diabetics; ref. to use of results e.g. to calculate insulin dose;</p> <p>production of insulin/humulin; ref. to regular injection/treatment with insulin for (insulin-dependent) diabetics; ref. to advantage of using human insulin/humulin e.g. fewer side effects; <span style="float: right;"><b>3</b></span></p>	

- (d) can be genetically engineered;  
ref. to ease of transfer; e.g. use of plasmid, splicing  
ref. to fast growth rates;  
(relatively) large quantities of product/mass production;  
ref. to smaller quantities using other means e.g. pig insulin;  
simple, culture medium/nutritional requirements/AW;  
fewer/no ethical issues;  
less chance of, contamination/named example (e.g. CJD);  
can be cultured anywhere in the world;  
(so) provides greater availability of (medical) product;  
cheaper costs, qualified/example given;  
AVP; e.g. ref. to avoiding, allergic/immune responses/side effects

**max 4****[Total: 15]**

Question	Expected Answers	Marks
4 (a)	<p>F1 stainless steel fermenter, with reason e.g. non-corrosive, easy to clean;</p> <p>F2 inoculum/starter culture, of fungus/<i>Penicillium</i>;</p> <p>F3 production of secondary metabolite;</p> <p>F4 antibiotic/penicillin, excreted into medium;</p> <p>F5 nutrients added at start;</p> <p>F6 process stopped, when maximum/high level antibiotic obtained;</p> <p>F7 limited/small amounts of, nutrient/glucose/lactose/nitrogen source added, at intervals/a slow rate;</p> <p>F8 glucose/lactose/corn steep liquor, as, C/energy, source/respiratory substrate;</p> <p>F9 nitrogen source e.g. yeast extract/corn steep liquor;</p> <p>F10 ref. <u>sterility</u>, e.g. fermenter/nutrients/air;</p> <p>F11 culture/cells, in contact with nutrients, using baffles/paddles/impeller/sparger/air bubbles;</p> <p>F12 air inlet/sparger, provides oxygen for, respiration/aerobic conditions;</p> <p>F13 (cold) water jacket, with reason e.g. remove excess heat from impeller/respiration, maintain, constant/optimum temperature;</p> <p>F14 temperature 24 – 30°C;</p> <p>F15 buffers/add acid or alkali, to maintain pH 6 – pH 8;</p> <p>F16 probes to monitor, oxygen/temperature/pH/pressure;</p> <p>F17 air outlet, to vent waste gases/avoid pressure build up;</p> <p>F18 AVP; e.g. ref. to growth in liquid medium addition of antifoam inoculum from small scale broth culture</p>	<p><i>max 6</i></p>
	<p>D1 fungal biomass/fungus/mycelium/<i>Penicillium</i>, separated from</p> <p>D2 medium/filtered;</p> <p>D3 cooling;</p> <p>D4 add potassium ions/use of solvent;</p> <p>D5 penicillin precipitates out as salt/crystallisation; AVP; e.g. centrifugation extraction solvent amyl/butyl acetate</p>	<p><b>max 8</b></p>
	<p><b>QWC – legible text with accurate spelling, punctuation and grammar;</b></p>	<p><b>1</b></p>

- (b) no bacterial colonies/growth near fungus; **A** *bacteria killed/inhibited*  
 smaller/type A, growing nearer to fungus; ora  
 antibiotic released by fungus/AW;  
diffusion through agar;  
 area/zone, of inhibition;  
 proportional to the effectiveness of the antibiotic/AW;  
 smaller colony/type A, less inhibited by antibiotic; ora **A** *antibiotic less effective* **max**  
**4**
- (c) *The binding of penicillin to the transpeptidase enzyme*
- acts as an inhibitor;  
 changes shape of active site of enzyme;  
 enzyme unable to, catalyse/bind; **A** *substrate cannot enter active site/  
 enzyme/substrate complex cannot form*  
 cell wall continues to be formed/new subunits added;  
 (but) no (peptide) cross links form;
- penicillin is only effective against growing bacteria*
- penicillin has its action when new cell wall (material) forming (in growing bacteria);  
 no effect on cell walls already formed;  
 ref. to enzyme not synthesised/inactive;
- binding of penicillin leads to osmotic lysis*
- cell wall weakened/AW;  
 water into cell by osmosis;  
 pressure, on wall/inside cell, leads to, lysis/bursting/AW;  
 rupture of cell membrane/AW;
- penicillin is not effective against Gram-negative bacterial cells*
- more complex structure/outer membrane/lipopolysaccharide;  
 impermeable to penicillin/AW;  
 penicillin unable to reach murein/peptidoglycan layer;  
 (therefore) unable to interact with enzyme/transpeptidase; **max**  
**7**

[Total: 20]

Question	Expected Answers	Mark
5	<p>1 use of starter culture/inoculum/lactic acid bacteria;</p> <p>2 any <b>two</b> named;</p> <p>3 milk heated/warmed, to begin souring/ripening process;  <b>R</b> <i>boiled/pasteurised</i></p> <p>4 ref. to multiplication of organisms/AW;</p> <p>5 anaerobic respiration produces lactic acid; <b>A</b> <i>ref. to anaerobes</i></p> <p>6 ref. to 'acid' taste of cheese;</p> <p>7 (therefore) pH decreases/pH to 4/continues souring;</p> <p>8 other organisms prevented, from growing/contaminating;</p> <p>9 ref. to flavours caused by, other biochemical changes/enzyme activity;</p> <p>10 detail; e.g. proteins to peptones and amino acids, fats to fatty acids and glycerol, production of amines, aldehydes, ketones</p> <p>11 rennet/rennin/chymosin added;</p> <p>12 enzyme, to coagulate (milk) proteins/caseinogens/convert caseinogens to casein;</p> <p>13 ref. to source of enzyme; e.g. calves stomachs, production by genetic engineering;</p> <p>14 ref to cutting/chopping/heating/scalding, to release whey from curd;</p> <p>15 controlled temperatures, to avoid killing starter culture/impairing flavour;</p> <p>16 ref. to use, of fungus/fungal spores, in blue-veined cheeses, to give flavours;</p> <p>17 <i>Penicillium roquefortii</i>;</p> <p>18 cheese pierced to allow air to penetrate for mould growth;  ref. to presence of other microorganisms on surface of cheese to give flavours;</p> <p>19 AVP;</p> <p>20 AVP e.g. lower pH only lactobacilli survive, gas/carbon dioxide production to give texture, named host for genetic engineering of rennin</p>	<p><b>max</b> <b>8</b></p> <p><b>1</b></p>
	<b>QWC – clear well organised using specialist terms;</b>	<b>1</b>

[Total: 9]



Question	Expected Answers	Marks
6 (a)	column/tube narrowing to smaller outflow drawn; alginate beads shown;  <i>labels</i> immobilised, enzyme/lactase (if label line to beads); <b>A</b> <i>alginate beads containing enzyme/lactase</i> filter/glass wool; <b>A</b> <i>other acceptable</i> tap; substrate/milk addition (at top); product/galactose and glucose collection (below);	<b>max 4</b>
(b)	use of clinistix/diastix; ref. to result;  <i>OR</i> add Benedict's reagent and boil; <b>A</b> <i>temperatures above 70°C</i> greater density of, precipitate/colour change, in product;  <i>OR</i> use of biosensor specific to <u>glucose</u> ; ref. to reading;	<b>max 2</b>
		<b>[Total: 6]</b>



**Mark Scheme 2805/05**  
**January 2007**

Question	Expected Answers	Marks
1 (a) (i)	<u>canine</u> ;	1
	(ii) <u>carnassial</u> ;	
	slice past each other as jaw is closed/AW; cut meat into smaller pieces/cut meat off bone; crack/crush, bones;	2 max 3 max
(b)	<i>heat loss</i> 1 body/blood, temperature rises; 2 may affect/denature, enzymes/proteins; 3 panting cools body; 4 ref. evaporative cooling;	
	<i>fate of lactate</i> 5 (high) lactate concentration needs to be reduced; 6 due to anaerobic respiration; 7 panting provides extra oxygen/ref. oxygen debt; 8 lactate oxidized to pyruvate;	
	<i>respiratory gases</i> 9 myoglobin would be reoxygenated; 10 haemoglobin would be reoxygenated; 11 ATP/CP, resynthesised in muscle tissue; 12 removal of extra carbon dioxide;	4 max
(c) (i)	A scapula B humerus C ulna D radius;	2 or 3 correct = 1 mark, 4 correct = 2 marks 2
	(ii) <i>ligament</i> holds bones together/prevents dislocation; high tensile strength; flexible;	
	<i>cartilage</i> ends of bones; low friction/smooth/slippery; ref. shock absorber/stops bones rubbing together;	4 max
	(iii) biceps/brachialis; (contraction) pulls on radius; flexor (muscle)/bends arm/pulls lower arm up;	2 max
	triceps; (contraction) pulls on end of <u>ulna</u> ; extensor (muscle)/straightens arm/pulls lower arm down;	2 max 3 max

Question	Expected Answers	Marks
2 (a)	1 carcinogens/named carcinogen; 2 (cause) mutation in, gene/DNA; 3 ref. oncogenes; 4 uncontrolled/AW, <u>mitosis</u> ; 5 mass of cells/tumour; 6 cells, abnormal (shape)/unspecialised; 7 AVP; e.g. metastasis/cells not destroyed by immune system/have own blood supply	3 max
(b)	1 fatty deposits in cells/AW; 2 hepatocytes/liver cells, destroyed/AW; <b>R</b> <i>damaged cells</i> 3 lobule structure lost; 4 scar/fibrous, tissue laid down AW; 5 ref. disruption to blood supply; 6 nodules form; 7 inflammation/hepatitis;	3 max
(c) (i)	death rate from cancer stayed fairly constant <b>and</b> death rate from cirrhosis fell steadily; death rate from cirrhosis always higher than death rate from cancer; comparative figs plus units;	2 max
(ii)	reduced alcohol intake; newer/more effective, drugs/treatments; earlier diagnosis; AVP; e.g. media campaigns about alcohol	1 max
(d) (i)	<b>A</b> prothrombin; <b>B</b> thrombin; <b>C</b> fibrinogen; <b>D</b> fibrin;	4
(ii)	enzyme/catalyst/description;	1
(iii)	blood does not clot; continue to bleed (for longer); haemophilia; internal, bleeding/bruising; AVP; e.g. entry of pathogens	2 max

[Total: 16]

Question	Expected Answers	Marks
3 (a) (i)	<u>30 kHz</u> ;	1
(ii)	192; ; <i>correct answer = 2</i> <i>allow one mark for correct working, e.g. 92/48 x 100</i>	2
(b)	1 oval window vibrates; 2 fluid in cochlea vibrates; 3 perilymph/endolymph; 4 receptor/hair, cells; 5 basilar membrane; 6 organ of Corti; 7 ref. stereocilia/hairs, bend; 8 (hair cells) resting potential; 9 generator potential; 10 (vibration causes) depolarisation (of hair cells); 11 release neurotransmitter; 12 causes depolarisation of neurones; 13 action potentials/impulses; 14 cochlear/auditory, nerve; 15 ref. frequency/pitch, detection; 16 ref. loudness detection; 17 AVP; e.g. ref. tectorial membrane	7 max
	<b>QWC– clear, well organised using specialist terms;</b>	1
(c) (i)	genetic code changed/mutation; detail of code change; ref. transcription; ref. translation; different, amino acid sequence/primary structure/secondary structure; non-functioning protein;	3 max
(ii)	deafness allele recessive; parents, heterozygous/carriers; child with hearing loss, homozygous recessive/gets allele for deafness from both parents; AVP; e.g. mutation in parents	2 max

[Total: 16]

Question	Expected Answers	Marks
4 (a) (i)	neurosecretion/exocytosis;	1
(ii)	TRH/thyrotropin releasing hormone; TSH/thyroid stimulating hormone;	
	<i>or</i>	
	GHRH/growth hormone releasing hormone; GH/growth hormone;	
	<i>or</i>	
	GnRH/gonadotrophin releasing hormone; LH/FSH/ICSH;	
	<i>or</i>	
	PRF/prolactin releasing factor; prolactin;	2 max
(b)	1 frequent need to urinate/diuresis;	
	2 large volume of urine/very dilute urine;	
	3 persistent feeling of thirst/excessive drinking;	
	4 electrolyte/mineral, imbalance;	
	5 AVP; e.g. dehydration,	3 max
		[Total: 6]

Question	Expected Answers	Marks
5 (a)	1 amylase in pancreatic juice; 2 adsorbed to epithelial cells/AW; <b>R absorbed</b> 3 of villi; ( <i>linked to 2</i> ) 4 starch to maltose; 5 glycosidic bonds broken by hydrolysis; 6 detail of hydrolysis; e.g. 1.4/1.6 links broken 7 maltase in cell membrane (of epithelial cells); 8 active sites exposed to outside; 9 maltose to glucose;	4 max
	10 (some) absorbed by (facilitated) diffusion; 11 active transport; 12 Na <sup>+</sup> pumped out of epithelial cells; 13 into tissue fluid (around capillary network); 14 Na <sup>+</sup> concentration low in epithelial cells/ref. Na <sup>+</sup> gradient; 15 Na <sup>+</sup> <u>diffuses</u> (from lumen) into cells; 16 carries glucose; 17 ref. co-transport/symport;	4 max
	18 AVP; e.g. brush border/movement of villi/digestion close to site of absorption	7 max
	<b>QWC – legible text with accurate spelling, punctuation and grammar;</b>	1
(b) (i)	absorb water; absorb, mineral ions/vitamins;	2
(ii)	fibre/cellulose/lignin; water; mucus; cells; bile salts/bile pigments/cholesterol; bacteria; AVP; e.g. virus	2 max
(c)	both benefit; microbes gain stable environment/AW; rabbit receives (extra) nutrients/AW;	2 max
(d)	( <i>nutrients released by microbes</i> ) <u>before</u> small intestine in cow; <u>after</u> small intestine in rabbit; need to pass through again for efficient absorption/AW;	2 max
(e)	(calcium ions/Ca <sup>2+</sup> ) released from sarcoplasmic reticulum; bind to troponin; troponin changes shape; troponin/tropomyosin, moves; myosin binding site exposed; myosin head binds (to actin);	3 max



Question	Expected Answers	Marks
6 (a)	<i>(Alzheimer's)</i> 1 reduced uptake of isotope/less positrons emitted/less glucose in brain 2 cells; 3 reduced blood flow; 4 reduced brain activity; 5 reduced respiration in cells; AVP; e.g. parts of brain <i>accept reverse argument for all points</i>	<b>3 max</b>
(b) (i)	control explained/AW; <b>R control without explanationf</b>	<b>1</b>
(ii)	mean number of errors reduced in subsequent trials; in all trials rats with phenserine had fewer errors/ora; ref. paired data for 2 trials;	<b>2 max</b>
(iii)	ref. trial and error; ref. associative learning; ref. operant conditioning; escape is reward/reinforcer;	<b>3 max</b>
(iv)	inhibits acetylcholinesterase; effect on enzyme; in synapses; slows down fall in ACh concentration/keeps some ACh at synapses/slows breakdown of ACh; in parts of brain associated with memory; improved <u>short term</u> memory;	<b>3 max</b>
(c)	innate/instinctive/stereotypic; inherited/genetic/inborn; does not require, learning/conscious thought; AVP; e.g. reflex	<b>3 max</b>
	searches for breast/bottle/AW;	<b>4 max</b>

**[Total: 16]**



**Mark Scheme 2806/01**  
**January 2007**

Question	Expected Answers	Marks
1 (a) (i)	91;	1
	(ii) genetic predisposition/hereditary/inherited risk; mutation, affecting mitosis/in cell cycle gene; mutation in, tumour suppressor gene/oncogene; faulty DNA repair, system/enzyme; AVP; e.g. p53/ras/BRCA1/retinoblastoma/familial polyposis of colon/ familial breast cancer/xeroderma pigmentosa	max 2
(b) (i)	$\frac{105}{(1.7)^2}$ ; A 105/2.89  BMI = 36; A 36.3 or 36.33	2
	(ii) BMI is 35 to 39.9; A <i>ecf</i> relative risk of dying is 1.45; A <i>number between 1.4 and 1.5</i> she is, 45%/nearly half as much again, more likely to die from cancer than non-obese person;	max 2
(c) (i)	later age at menopause increases, risk/incidence, of breast cancer; ORA	1
	(ii) straight line on graph showing positive correlation;	1
(d)	cross, cell/phospholipid, membrane/bilayer; fat soluble/soluble in phospholipids/AW; diffusion; R <i>facilitated diffusion or reference to membrane pores</i> down concentration gradient/AW; AVP;	max 2
		[Total: 11]

- 2 (a) plants/protocists;  
animals/fungi/protocists;
- A** *protocists once only* **R** *taxa that are not kingdoms* **2**
- (b) *energy*  
movement/locomotion/muscle contraction/cilia/flagella;  
active transport; **A** *example*  
anabolic reactions/AW; **A** e.g. *protein synthesis/DNA replication*  
(movement of chromosomes in) mitosis/meiosis;  
nerve impulse/electrochemical gradients;  
maintain body temperature/generate heat;  
AVP; (eg bioluminescence/electrical discharge)  
AVP; (detail of any point) **3 max**
- carbon*  
in, biochemicals/macromolecules; **A** *in organic matter*  
e.g. carbohydrate/protein/lipid/nucleotide/nucleic acid; **A** *named examples*  
growth;  
repair;  
AVP; e.g. detail of any point) **3 max** **max**  
**4**
- (c) (nitrifying bacteria) help/increase, plant growth;  
bacteria make nitrate (available);  
plants need nitrate;  
for, amino acids/protein/chlorophyll/DNA; **max**  
for, new cells/mitosis/new leaves; **2**
- (d) (i) chemoheterotrophic; **1**
- (ii) photoautotrophic; **1**
- (e) (i) carbon; **R**  $\text{CO}_2$  **1**
- (ii) *Desulfovibrio*, uses sulphur (S)/makes hydrogen sulphide ( $\text{H}_2\text{S}$ );  
green sulphur bacteria, use  $\text{H}_2\text{S}$ /make S;  
colourless sulphur bacteria use  $\text{H}_2\text{S}$ ; **max**  
**2**
- (f) colourless sulphur bacteria; **1**
- (g) *C. perfringens* similar to *C. difficile*/AW;  
(bacteria) anaerobic;  
(tissue damage/poor blood supply) decreases oxygen available;  
conditions suitable for *Clostridium* to multiply;  
AVP; **max**  
**2**
- [Total: 16]**

Question	Expected Answers	Marks
3 (a)	<p>for, flying/hovering/beating wings;  muscle activity/AW;  ref. ATP/respiration;  AVP; e.g. explanation of energy demand of flight</p> <p>small size qualified; e.g. increases heat loss/ref. large surface area to volume ratio</p> <p>homeothermic qualified;</p> <p>migration qualified;</p> <p>feather growth qualified; e.g. ref. mitosis/protein synthesis</p>	<b>max 4</b>
(b) (i)	<p><i>description</i></p> <p><b>D1</b> high(est) incidence of torpor/AW;  <b>D2</b> low(est) oxygen consumption/AW;  <b>D3</b> high(est) body mass/AW;  <b>D4</b> data quote;</p> <p><i>explanation</i></p> <p><b>E1</b> less food used;  <b>E2</b> (for) less respiration/lower BMR/lower body temperature;  <b>E3</b> more food stored;  <b>E4</b> as fat;  <b>E5</b> (food store/fat) for, migration/flight;</p>	<b>3 max</b>
(c)	<p>flying, easier/uses less energy (with incomplete feathers if mass low);  can, escape predators/find food, (by flying);  food used for feather growth;  therefore, fat stores used/less food stored;  incomplete/missing feathers may reduce body mass;</p>	<b>max 2</b>
(d)	<p>yes</p> <p>(autumn) high(est) mass birds have low(est) oxygen consumption;  (spring) low(est) mass birds have high(est) oxygen consumption;  data quote mass plus O<sub>2</sub> consumption;  only generate heat in proportion to (small) mass;  but lose it in proportion to (large) surface area;  homeothermic/small birds find it hard to keep warm;</p>	<b>max 3</b>
		<b>[Total: 13]</b>

Question	Expected Answers	Marks
4	1 blood = transport fluid/AW; 2 blood has high (hydrostatic) pressure; 3 tissue fluid created/plasma moves out of capillaries/AW;  4 named substance; glucose/amino acids/fatty acids/glycerol, oxygen, carbon dioxide, urea 5 from area; gut, alveoli, liver cell, liver cell 6 moves to; blood/liver cell, blood/liver cell, tissue fluid/alveoli, tissue fluid/kidney 7 method; diffusion/facilitated diffusion/active transport/ endocytosis, diffusion, diffusion, diffusion 8 detail of transport in blood; plasma/dissolved, red blood cells/ haemoglobin, HCO <sub>3</sub> <sup>-</sup> ions/dissolved/carbamino- haemoglobin, plasma/dissolved  9 ref. respiration; 10 ref. maintaining diffusion gradients;  11 osmoregulation by kidney/AW; 12 pH regulation by kidney/AW; 13 ref. osmosis;  14 AVP; e.g. deamination, ornithine cycle, ref. CO <sub>2</sub> acidic 15 AVP; e.g. ref. glycogen, ref. insulin/glucagon	
		max 7
	<b>QWC – legible text with accurate spelling, punctuation and grammar;</b>	<b>1</b>

**[Total: 8]**

Question	Expected Answers	Marks
5 (a)	cut/damage, breaks tonoplast/opens vacuole/mixes enzyme and precursor/ AW; enzyme-substrate collisions/AW; (enzyme-substrate complex) releases, smell/volatile chemicals;	3
(b)	less precursor chemical; due to, herbivore/fungal/bacterial damage; due to sulphur recycling; due to onion being older; used pyruvate for, link reaction/Krebs cycle/respiration; AVP;	max 2
(c) (i)	identify mildest/AW; and breed together; detail cross-pollination; idea, repeat/many generations AW; <u>directional selection</u> ; AVP; e.g. reference to frequency of <u>alleles</u>	max 3
(ii)	grow in low level of, sulphur/sulphate;	1
(d)	method of quantifying onion strength/producing extracts of different concentration; method of measuring, rotting/antibiotic effect of onion extract; replicates/mean; ref. control variable or example; ref. fungi/bacteria; AVP; e.g. reference to timescale AVP; e.g. second controlled variable	max 3

[Total: 12]



**Mark Scheme 2806/03**  
**January 2007**

**Planning Exercise**

The mark scheme for the planning exercise is set out on page 4. The marking points A to U follow the coursework descriptors for Skill P.

Indicate on the plans where the marking points are met by using a tick and an appropriate letter. There are 14 marking points for aspects of the plan and two marks for quality of written communication (QWC).

**Practical Test**

Pages 5 to 7 have the mark scheme for Questions 1 and 2 for the Practical Test.

**A2 Biology. Planning exercise**

Check- ing Pt	Descri ptor	The candidate
A	P.1a	Plans a suitable procedure that involves: <b>either</b> crossing purple-stemmed and green-stemmed tomato plants and growing the F1/F2, <b>or</b> growing green- and purple-stemmed tomato plants at different temperatures and different light intensities;
B	P.1a	Gives a reasonable prediction e.g. purple-stemmed x green stemmed-tomato plants will give purple-stemmed plants, e.g. tomato plants exposed to higher light intensities and temperature will have darker-purple stems;
C	P.1b	Selects suitable equipment and materials e.g. paint brush for cross-pollination, way to prevent cross-pollination, light source, light meter, propagator, thermometer;
D	P.3a	Identifies at least 2 key factors to control – one related to growing seeds e.g. depth of planting seeds, watering regime, and one related to light or temperature, e.g. light intensity when investigating temperature, etc.;
E	P.3a	Decides on appropriate number of measurements to take: minimum of fifty offspring from each cross and ten seeds germinated in each treatment to find effect of light intensity/temperature;
F	P.3b	Decides on a suitable range of light intensities and temperatures;
G	P.3b	Decides on an appropriate range of crosses including homozygous purple x green and F1 cross;
H	P.3b	Uses appropriate scientific knowledge and understanding in developing a plan e.g. meiosis, monohybrid cross, $\chi^2$ test, germination conditions;
I	P.5a	Describes a way of obtaining reliable results, e.g. reciprocal crosses, replicate crosses and repeating growing conditions (several pots of seeds in same conditions);
J	P.5a	Uses results from preliminary work or previous practical work in developing a plan;
K	P.5a	Refers to a safety aspect e.g. fungicide on seeds, electric lamps, allergy to tomato;
L*	P.5b	<i>Gives a clear account, logically presented with accurate use of scientific vocabulary (QWC);</i>
M	P.5b	Describes way(s) of obtaining precise results e.g. distinguishing gradations of colour (use of colour comparator), not counting same seedling twice, how to achieve and measure different light intensities or temperatures;
N	P.7a	Uses information from at least two identified sources e.g. a text book/web site etc;
O	P.7a	Shows how results are to be presented in the form of a table
P	P.7a	Uses appropriate scientific knowledge and understanding from AS specification e.g. gene expression, enzyme function, nature of mutation, pigment development;
Q*	P.7b	<i>Uses spelling, punctuation and grammar accurately (QWC);</i>
R	P.7b	<u>Explains</u> how data would be interpreted to find the answer to the investigation e.g. interpretation of $\chi^2$ test;
S	P.7b	Comments on precision and/or reliability e.g. use muslin/paper, bags to prevent contaminant pollen, remove anthers to prevent self-pollination, <u>explains</u> why large numbers of offspring/seedlings required;
T	P.7b	Comments on precision and/or reliability with respect to other environmental conditions e.g. wavelength of light, photoperiods, planting density;
U	P.7b	Uses test cross(es) to check purple plants are pure breeding/homozygous;

Question	Expected Answers	Marks
1 (a)	table with conc <sup>n</sup> of salt/tube in the first column; informative, column headings; e.g. conc <sup>n</sup> of NaCl, time, distance, rate correct units in all column headings (% <u>and</u> mm <i>or</i> cm/min <i>or</i> sec, <u>and</u> mm (cm) min <sup>-1</sup> <i>or</i> mm (cm) s <sup>-1</sup> ); NaCl concentrations adjusted for dilution effect (ie half those given); time recorded in seconds; rates calculated correctly; appropriate trend;	7 max
(b)	axes round right way ( <i>x</i> axis = concentration of salt, <i>y</i> axis = time/rate); axes labelled and scaled and units in ascending order; uses half or more of both axes; points accurately plotted; points joined, neatly/clearly, by straight lines unless conform to line of best fit;	5
(c)	trend described (decrease in rate/increase in time, with increase in concentration); comment on shape of curve; comparative data quote; (conc <sup>n</sup> s and rates) identifies any anomaly; ora	3 max
(d)	carbon dioxide (collects in the syringe); pressure increases forcing suspension down tube/displaces yeast solution;	2
(e)	carbon dioxide produced (by) decarboxylation; (in) link reaction; pyruvate → acetyl co-enzyme A; (and) Krebs cycle; detail of Krebs cycle; e.g. C6 to C5/C5 to C4 (in) mitochondria; (during) aerobic respiration;  (also) pyruvate → ethanol; in cytoplasm; (during) anaerobic respiration;	5 max
(f)	solute/water, potential, lowered/made more negative, by salt; water, moves/diffuses, out of yeast cells; down water potential gradient; by osmosis; causing plasmolysis; disruption to, membranes/enzymes (so respiration slows or stops); those at lower salt concentrations are salt tolerant; appropriate comparative data quote;	5 max

- (g) gene in transformed plants present in (their) gametes;  
 ref meiosis;  
 detail of meiosis; e.g. segregation  
 plants effectively heterozygous;  
*HAL 1* in 50% of gametes;  
 (therefore) 75% of offspring inherit salt tolerance/25% do not inherit salt tolerance;

**2 max****(f)** *limitations*

- 1 reading level in syringes not accurate (e.g. air bubbles/reading meniscus);
- 2 yeast settles in syringe;
- 3 different numbers of yeast cells in suspension in each tube;
- 4 pH decreases during course of reaction;
- 5 detail reason for/effect of falling pH;
- 6 temperature not controlled/was not kept constant;
- 7 temperature effects on, volume/pressure, in syringe;
- 8 apparatus may not be airtight;
- 9 delay between marking starting-point and reading stopwatch;
- 10 ref to problem of measuring distance accurately (width of marker pen/ruler);
- 11 no repeats/do more repeats/calculate means; ora
- 12 anomalies not identified;
- 13 contamination due to reuse of syringe;
- 14 AVP; e.g. glucose may be a limiting factor;  
 concentration of enzyme may vary;

*improvements*

- 14 use graduated pipette/burette (to measure volumes);
- 15 use buffer (solution);
- 16 use intermediate concentrations of salt;
- 17 use wider range of concentrations;
- 18 more accurate scale on tubing;
- 19 measure volumes of gas/CO<sub>2</sub> produced;
- 20 detail e.g. use gas syringe;
- 21 control with, no/dead, yeast;
- 22 AVP;

**10 max****[Total: 30]**

Question	Expected Answers	Marks
2 (a)	<p><i>Drawing</i></p> <p>clear continuous lines;  no shading;  cellulose wall double lines;  cell and chromosomes correct, shapes/proportions;  cytoplasm and nucleus present (i.e. as at prophase 1) <u>and</u> correct proportions;</p> <p><i>Labels and annotations</i></p> <p>cell wall;  suitable annotation e.g. thin;</p> <p>cytoplasm;  suitable annotation e.g. granular/clear;</p> <p>nucleus/nuclear, membrane/envelope;  suitable annotation e.g. large/thin;</p> <p>chromosome(s)/chromatid(s)/bivalent(s);  suitable annotation e.g. darkly stained;</p> <p>chiasma(ta)/chromatids crossing over;</p> <p>AVP; e.g. reference to nucleolus;</p>	<p><b>4 max</b></p> <p><b>6 max</b></p>
(b)	<p>thin section made through narrow plane of cell/AW;  not all chromosomes present in same plane/AW;</p>	<p><b>2</b></p>
(c) (i)	<p>chromosomes more condensed;  chromosomes in different position;  no chiasmata visible;  nuclear membrane/nucleus not visible;  no nucleolus;  cell wall thicker;  differently, stained/coloured;</p>	<p><b>2 max</b></p>
(ii)	<p>nuclear membrane disperses;  chromosomes/bivalents, move to equator of cell;  crossing over/chiasmata, completed;  spindle forms;  spindle fibres attach to centromere;  spindle fibres shorten; <b>A contract</b>  (homologous) chromosomes separate;</p>	<p><b>4 max</b></p>
(d)	<p>contain <u>haploid</u> number;  compensates for doubling that takes place at fertilisation;  restoring diploid number;  contributes to genetic variation;</p>	<p><b>2 max</b></p>

**Advanced GCE Biology (3881 / 7881)  
January 2007 Assessment Series**

**Unit Threshold Marks**

<b>Unit</b>		<b>Maximum Mark</b>	<b>a</b>	<b>b</b>	<b>c</b>	<b>d</b>	<b>e</b>	<b>u</b>	<b>entry</b>
<b>2801</b>	Raw	60	48	43	38	33	28	0	20224
	UMS	90	72	63	54	45	36	0	
<b>2802</b>	Raw	60	42	38	34	30	27	0	6707
	UMS	90	72	63	54	45	36	0	
<b>2803A</b>	Raw	120	95	85	75	65	55	0	772
	UMS	120	96	84	72	60	48	0	
<b>2803B</b>	Raw	120	95	85	75	65	55	0	1270
	UMS	120	96	84	72	60	48	0	
<b>2803C</b>	Raw	120	86	78	70	62	54	0	1116
	UMS	120	96	84	72	60	48	0	
<b>2804</b>	Raw	90	65	57	50	43	36	0	11343
	UMS	90	72	63	54	45	36	0	
<b>2805A</b>	Raw	90	61	54	48	42	36	0	110
	UMS	90	72	63	54	45	36	0	
<b>2805B</b>	Raw	90	65	57	49	42	35	0	45
	UMS	90	72	63	54	45	36	0	
<b>2805C</b>	Raw	90	56	51	46	41	37	0	173
	UMS	90	72	63	54	45	36	0	
<b>2805D</b>	Raw	90	68	59	51	43	35	0	186
	UMS	90	72	63	54	45	36	0	
<b>2805E</b>	Raw	90	66	58	51	44	37	0	515
	UMS	90	72	63	54	45	36	0	
<b>2806A</b>	Raw	120	90	81	72	63	55	0	1261
	UMS	120	96	84	72	60	48	0	
<b>2806B</b>	Raw	120	90	81	72	63	55	0	60
	UMS	120	96	84	72	60	48	0	
<b>2806C</b>	Raw	120	83	75	67	59	51	0	666
	UMS	120	96	84	72	60	48	0	

## Specification Aggregation Results

Overall threshold marks in UMS (i.e. after conversion of raw marks to uniform marks)

	<b>Maximum Mark</b>	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	<b>E</b>	<b>U</b>
<b>3881</b>	300	240	210	180	150	120	0
<b>7881</b>	600	480	420	360	300	240	0

The cumulative percentage of candidates awarded each grade was as follows:

	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	<b>E</b>	<b>U</b>	<b>Total Number of Candidates</b>
<b>3881</b>	16.5	33.3	53.0	74.6	93.0	100.0	701
<b>7881</b>	12.2	46.8	68.1	87.2	94.7	100.0	202

### **3881**

701 candidates aggregated this series

### **7881**

202 candidates aggregated this series

For a description of how UMS marks are calculated see;  
[http://www.ocr.org.uk/exam\\_system/understand\\_ums.html](http://www.ocr.org.uk/exam_system/understand_ums.html)

Statistics are correct at the time of publication



**OCR (Oxford Cambridge and RSA Examinations)**  
**1 Hills Road**  
**Cambridge**  
**CB1 2EU**

**OCR Customer Contact Centre**

**(General Qualifications)**

Telephone: 01223 553998

Facsimile: 01223 552627

Email: [helpdesk@ocr.org.uk](mailto:helpdesk@ocr.org.uk)

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